R E P O R T R E S U M E S

ED 017 150 EF 001 310

SOUTH CAROLINA SCHOOL FACILITIES PLANNING AND CONSTRUCTION GUIDE.

BY- MCELVEEN, W. POWERS
SOUTH CAROLINA STATE DEPT. OF EDUCATION, COLUMBIA

PUB DATE 67

EDRS PRICE MF-$0.50 HC-$3.36 82P.

DESCRIPTORS- *DESIGN NEEDS, *EQUIPMENT STANDARDS, *SCHOOL CONSTRUCTION, *STATE STANDARDS, CONTROLLED ENVIRONMENT, HEALTH NEEDS, SCHOOL SAFETY, SPACE REQUIREMENTS,

THIS GUIDE PRESENTS A SET OF REGULATIONS FOR PLANNING AND CONSTRUCTING PUBLIC SCHOOL BUILDINGS. THE AREAS COVERED ARE--(1) DRAWING REQUIREMENTS, (2) POLICIES GOVERNING SCHOOL SITES, MINIMUM FACILITIES, AND SPACE ALLOWANCE, (3) DESIGN AND CONSTRUCTION STANDARDS RELATING TO HEATING, AIR CONDITIONING, AND VENTILATION, (4) ELECTRICAL, INCLUDING LIGHTING, (5) PLUMBING, (6) FEDERAL AID PROJECTS, (7) SAMPLE FORMS, (8) RULES AND REGUALTIONS OF THE BOARD OF HEALTH, AND (9) FALLOUT SHELTERS. TABLES ARE PROVIDED FOR--(1) MINIMUM LEVELS OF ILLUMINATION, AND (2) WORKING HEIGHTS FOR SCHOOL FIXTURES AND EQUIPMENT. ILLUSTRATIONS ARE GIVEN OF FALLOUT SHELTER PLANS, ELEVATIONS, AND DETAILS. (MM)

ED017150

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

- 1967 -

SOUTH CAROLINA

SCHOOL FACILITIES PLANNING

AND CONSTRUCTION GUIDE

Prepared by

Schoolhouse Building and Planning Section

under the direction of

W. Powers McElveen, Assistant Director

STATE DEPARTMENT OF EDUCATION

Office of Schoolhouse Building, Planning and Transportation

R. A. Durham, Director

Columbia, South Carolina

CYRIL B. BUSBEE, STATE SUPERINTENDENT OF EDUCATION

EF 001310

SOUTH CAROLINA

STATE BOARD OF EDUCATION

Mr. Cyril B. Busbee, State Superintendent of Education

Secretary and Administrative Officer to the Board

Mr. William H. Seals, Chairman, Marion	Circuit 12
Mr. E. Crosby Lewis, Vice Chairman, Columbia	Circuit 5
Mr. D. Houser Banks, St. Matthews	Circuit 1
Mr. Thomas R. Jackson, Williston	Circuit 2
Mr. N. J. Laney, Bishopville	Circuit 3
Mr. Laurens W. Floyd, Dillon	Circuit 4
Dr. Richard Y. Westcoat, Lancaster	Circuit 6
Mr. J. Claude Fort, Gaffney	Circuit 7
Dr. J. Calvin Koonts, Due West	Circuit 8
Mr. John T. Welch, Jr., Charleston	Circuit 9
Mr. Curtis Pennington, Starr	Circuit 10
Mr. E. Hite Miller, Trenton	Circuit 11
Dr. Brown Mahon, Greenville	Circuit 13
Mr. G. A. Hoffman, Walterboro	Circuit 14
Dr. R. Cathcart Smith, Conway	Circuit 15
Mr. William B. White, Jr., Rock Hill	Circuit 16

STATE EDUCATIONAL FINANCE COMMISSION

	Congressional District
Mr. W. H. Nicholson, Jr., Chairman, Greenwood	3
Mr. Johnnie B. Rhodes, Walterboro	1
Mr. Lester L. Bates, Jr., Columbia	2
Mr. Ralph Walker, Greenville	4
Mr. W. J. Neely, Rock Hill	5

9/67

INDEX

Page Number

CHAPTER I General

1.100 Architect-Engineer 1
1.101 State Board of Health's Approval 1
1.102 Building Codes 1

CHAPTER II Drawing Requirements

2.100 Preliminary Drawings 1
2.101 Final Working Drawings and Specifications 3

CHAPTER III Policies Governing School Sites, Minimum Facilities and Space Allowance

3.100 School Sites 1
3.101 Primary and Elementary Classrooms 3
3.102 Jr. High and High School Classrooms 3
3.103 Elementary School Library 5
3.104 Junior High & High School Library 5
3.105 Cafeterias 6
3.106 Kitchens 7
3.107 Entrances and Corridors 7
3.108 Toilet Rooms 8

CHAPTER IV Design and Construction Standards Relating to Heating, Air Conditioning, and Ventilation

4.100 General 1
4.101 Design Conditions 1
4.102 Boilers and Boiler Clearance 2
4.103 Boiler Accessories 2
4.104 Stacks, Chimneys and Breeching 3
4.105 Mechanical or Boiler Room 4
4.106 Fuel Storage 5
4.107 Operating and Maintenance Instructions 6
4.108 Guarantees and Warrantees 6
4.109 Inspection 7
4.110 Service Calls 8

CHAPTER V Electrical

5.100 Responsibility of Design 1
5.101 Material and Workmanship 1
5.102 Minimum Levels of Illumination 1
5.103 Fire Alarm 3
5.104 Panel Directory 3
5.105 Exit Lights 3
5.106 Light Fixtures 4
5.107 Convenience Outlets 4
5.108 Engineers Statement of Inspection 4

CHAPTER VI Plumbing

6.100 Codes and Regulations 1
6.101 Working Heights 1
6.102 Water Supply and Sewage Disposal 2
6.103 Lunchrooms and Cafeterias 2
6.104 Working Heights for School Fixtures and Equipment . 3

CHAPTER VII Federal Aid Projects Under Public Law 89-10, Title 1

7.100 Wage Determination and Labor Standards Forms . . . 1
7.101 Liquidated Damages Clause 2

CHAPTER VIII Sample Forms

8.100 Application for Approval of Final Plans and Specifications
8.101 Tentative Specifications to be Submitted With all Preliminary Plans

CHAPTER IX Rules and Regulations of the S. C. State Board of Health Relating to the Sanitation of Schools 1

CHAPTER X Fallout Shelters 1

CHAPTER I

GENERAL

1.100 ARCHITECT

All new buildings and additions and/or renovations to existing buildings concerning the public education program in South Carolina must have plans and specifications prepared by an architect experienced in and legally qualified to practice in South Carolina.

1.101 STATE BOARD OF HEALTH'S APPROVAL

No system of water supply, plumbing, sewage, garbage or refuse disposal, or food handling facilities for any public school shall be installed, nor shall any such existing system be materially altered or extended until complete plans and specifications for the installation, alteration or extension, together with such information as the Board of Health may require, have been approved.

1.102 BUILDING CODES

The Southern Standard Building Code (type IV non-combustible) and codes referred to therein, and Rules and Regulations of the State Fire Marshal, and applicable local codes shall govern the design and construction standards when they are more stringent than these regulations.

CHAPTER II

2.100 PRELIMINARY DRAWINGS

The preliminary drawings as prepared by the architect or engineer shall be submitted to the Division of Schoolhouse Building, Planning and Transportation in duplicate for review and approval.

All preliminary plans must contain the following to be considered:

1. Site Description

   A topographical map of the site showing:

   a. Acreage in site.

   b. Site boundary lines.

   c. Orientation.

   d. Existing and proposed contours.

   e. Location of proposed new building (with possible extension) and its relation to the present and future grade levels.

   f. Water, gas, electrical and sewage facilities or service connections.

   g. General scheme of recreation facilities, primary landscaping features, walks, drives, parking areas.

   h. Adjacent properties, buildings, streets, highways, etc.

   i. Location of test pits or borings.

   j. Wooded area and ditches, if any.

2. Floor Plans and Sections

   a. Complete floor layout at 1/8" scale unless exceptionally large complex and in this case a scale of 1/16" will be acceptable.

b. If the entire school floor plan is not contained on a single sheet, then it will be necessary to include a small key plan in the bottom right hand corner. This key plan shall indicate the portion of the floor plan that is drawn on the respective sheet.

c. Cross sections of the following spaces shall be drawn:

(1) Typical classroom

(2) Shop or shops

(3) Auditorium

(4) Gymnasium - Gymnatorium

(5) Cafeteria - Cafetorium

(6) Library

(7) Home Economics

(8) Science Rooms

(9) Band

d. Layout plans for the following areas shall be prepared at: 1/4" = 1' -0" scale.

(1) Typical classroom

(2) Shop or shops

(3) Library

(4) Science

(5) Band and Music

(6) Cafeteria and Kitchen

(7) Home Economics

3. <u>Elevations</u>

a. Front Elevation

b. Rear Elevation

c. End Elevation

4. Tentative Specifications

a. Complete one copy of our "Tentative Specification" form and submit along with the preliminary plans. (See sample set in Chap. 8)

2.101 FINAL WORKING DRAWINGS AND SPECIFICATIONS

1. Written approval must be received on preliminary plans before proceeding with the final plans and specifications.

2. Final Submission Requirements

a. Two complete sets of plans and specifications.

b. One partial set of plans (a set of plans containing only the sheets concerning water supply, sewerage system, toilets, kitchen, etc.) to be sent directly to the County Sanitarian in whose district the work is to be performed.

c. One completely executed copy of the "Application for Approval of Final Plans and Specifications". (See sample copy in Chap. 8)

d. No deviation from the plans as approved shall be allowed unless approved in writing by the Office of Schoolhouse Planning.

e. Under all sections the clause "or equal" shall be included.

f. Specifications shall state the number of calendar days for completing the job from the date of awarding contract.

g. In all cases of gymnasiums, auditoriums, shops or other long span spaces, a structural designing engineer must be used and his stamp and license number must appear on each sheet of the design.

h. Kitchen equipment plans and specifications must be submitted with final plans.

3. Procedure To Be Followed After Approval Received

a. Make all corrections to plans and specifications as required by this agency.

b. Advertise project a minimum of three times in a newspaper of general circulation in the State over a 30 day period following receipt of written final approval. If advertising is delayed longer than six months after completion of working drawings, a new evaluation and approval by the Division of Schoolhouse Building, Planning and Transportation shall be obtained before advertisement for bids.

c. Forward one copy of each of the following documents to this office prior to bid date:

(1) Copy of advertisement

(2) Addendums and/or Bulletins

d. Forward one copy of each of the following documents to this office after bids received:

(1) Bid Tabulation

(2) Copy of contractor's cost breakdown

(3) Contract between owner and contractor on standard A.I.A.Form

(4) 100% performance bond on standard A.I.A. Form

(5) 100% labor and material payment bond on standard A.I.A. Form

(6) Evidence of contractor's insurance

(7) Evidence of Builder's Risk Insurance

(8) Change Orders - Forward all copies to this office before a firm commitment is made to the contractor.

Provide a space on all Change Orders for approval as follows:

Division of Schoolhouse Building, Planning and Transportation
STATE DEPARTMENT OF EDUCATION

(9) Certificates for payment

(10) One copy of the architect's and/or engineer's Pre-Final punch list. All items on this list must be corrected prior to notifying this office that the project is ready for a final inspection.

e. No newly constructed or remodeled school building shall be occupied or final payment issued until it has been approved by a representative of this office.

f. No deviation from the plans and specifications are to be made unless approved in writing by this office.

Provide a space on all Change Orders for approval as follows:

Division of Schoolhouse Building, Planning and Transportation
STATE DEPARTMENT OF EDUCATION

(9) Certificates for payment

(10) One copy of the architect's and/or engineer's Pre-Final punch list. All items on this list must be corrected prior to notifying this office that the project is ready for a final inspection.

e. No newly constructed or remodeled school building shall be occupied or final payment issued until it has been approved by a representative of this office.

f. No deviation from the plans and specifications are to be made unless approved in writing by this office.

CHAPTER III

POLICIES GOVERNING SCHOOL SITES, MINIMUM FACILITIES AND SPACE ALLOWANCE

The following criteria relating to school centers has been used in developing standards to be observed in planning buildings.

3.100 School Sites

1. Size of Sites

   a. The minimum size of the school site shall be:

      1. For an elementary school - 10 acres plus 1 acre for each 100 pupils to be enrolled. Anticipate future enrollment.
      2. For junior high schools - 20 acres plus 1 acre for each 100 pupils to be enrolled. Anticipate future enrollment.
      3. For senior high schools - 30 acres plus 1 acre for each 100 pupils to be enrolled. Anticipate future enrollment.

   b. Sites with less acreage than established in item 1.a. shall be considered for approval by the Division of Schoolhouse Building, Planning and Transportation and by the State Board of Education.

2. Miscellaneous Factors

   a. Must be near pupil population center and, insofar as possible, the future school population.

   b. Site is to be free from disturbing noises such as those resulting from shopping centers, heavy truck, automobile, railway and airplane traffic. Other factors to consider are fire sirens, factory whistles, planing mills, saw mills and other noisy industries.

   c. Availability of public utilities such as water, gas, sewers, fire protection, police protection, transportation, telephone,

and electricity for power and light is to be most carefully considered.

d. Careful attention should be given to the transportation problems. A site that affords easy access for buses, bicycles and private vehicles is highly desirable. Avoid locations where rush-hour traffic congestion can be a problem.

e. Provide adequate bus parking in schools where buses terminate. Bus parking should be separated from parking areas set aside for automobiles and bicycles.

f. Provide adequate parking for faculty members, students and visitors.

g. Bicycle parking should be provided near the building and away from the other parking areas. Avoid the necessity of bicycle and automotive traffic having to use the same driveways, etc.

3. Selection of Sites

a. The local school district has the responsibility for selection of school sites, but new school sites or additions to existing sites must be approved by a representative of the Division of Schoolhouse Building, Planning and Transportation.

b. Any approved site that does not have existing approved water supply and sewerage facilities available for connection must not be purchased out-right. An option must be obtained, of sufficient duration, to allow the school board to determine the existance of an adequate water supply. Soil conditions, etc., must be investigated concerning sewage disposal. Negative results of the investigations will be mandatory grounds for rejection of the site for school use.

3.101 Primary and Elementary Classrooms

1. Provide a minimum of 720 square feet of floor area exclusive of toilets and/or storage area.
2. Each elementary classroom shall be equipped with a minimum of:

   16 lineal feet of chalkboard

   16 lineal feet of tackboard

   10 lineal feet of coat hanging facility

   1 teacher's cabinet

   1 storage cabinet.

3. Provide electrical convenience outlets on at least ~~three~~ two walls.
4. The minimum width of the classrooms shall be not less than 24 feet.
5. The minimum ceiling height shall be 9 feet from the floor to the lowest point above the floor.
6. Classrooms may have as little as one window, provided the space is mechanically ventilated and/or air conditioned. (See ventilation requirements in Chapter 4).
7. Any classroom located on an exterior wall must have in addition to the door opening into the corridor a minimum of one window and a door opening directly to the outside. The door opening to the outside may be eliminated, provided the window is operable as ~~the~~ a door for emergency egress or meets the minimum requirements for opening.
8. All classroom doors must open in direction of egress.
9. All classrooms must have an approved floor covering.
10. Grades K-3 must be provided with a toilet and sink.

3.102 Junior High and High School Classrooms

1. Provide a mimimum of 720 square feet of floor area.
2. Each classroom shall contain a mimimum of:

   16 lineal feet of chalkboard

   12 lineal feet of tackboard

   1 teacher's cabinet.

3. Provide electrical convenience outlets on at least three walls.
4. The minimum width of the classrooms shall not be less than 24 feet.
5. The minimum ceiling height shall be 9 feet from the floor to the lowest point above the floor.
6. Classrooms on outside walls may have as little as one window provided the space is mechanically ventilated and/or air conditioned. (See ventilation requirements in Chapter 4).
7. Any classroom located on an exterior wall must have, in addition to the door opening into the corridor, a minimum of one window and a door leading directly to the outside. The door leading to the outside may be eliminated provided the window is operable as a door for emergency egress.
8. Only internal instructional spaces resulting from a compact building design are accepted without windows and then only under the following conditions:
    a. Instructional spaces must be air conditioned.
    b. Provide two widely separated doors to corridor.
    c. All interior partitions must have a minimum of one hour fire rating and extend through the ceiling to the bottom of roof deck or floor system above.
    d. Must provide a minimum of one skylight located above door leading to corridor.
9. All classrooms must have an approved floor covering.
10. All classroom doors must open in direction of egress.

3.103 ELEMENTARY SCHOOL LIBRARY

1. Reading Room

   Provide a minimum of 1300 square feet of floor area.

2. Work Room-Conference Room

   Provide a work room with sink, work counter and adequate storage cabinets for supplies, etc. A conference room shall be provided immediately adjacent to the reading room.

3. Shelving

   Wall shelving shall accommodate ten (10) books per total pupil enrollment with a minimum of not less than 1000 books. Allow additional special sections of shelving for magazines, newspapers, etc.

4. Audio-Visual Material and Equipment

   Each library shall have space for audio-visual material and equipment unless provided for otherwise.

5. Sight Control

   The Librarian must have sight control of the entire library from any location within the library.

3.104 JUNIOR HIGH AND HIGH SCHOOL LIBRARY

1. Reading Room

   In schools of 400 or more, the library quarters shall be large enough to seat fifteen per cent (15%) of the first 500 enrollment plus 10% of all above 500 (not to exceed 100 pupils). In schools of less than 400, the library shall be large enough to seat the largest class plus 20. Allow twenty-five (25) square feet of floor space per pupil in the reading area.

2. Work Room-Conference Room

   Provide a work room with sink, work counter and adequate storage cabinets for supplies, etc. A conference room shall be provided immediately adjacent to the reading room.

3. Shelving

Wall shelving shall accommodate eight (8) books per total pupil enrollment with a minimum of not less than 1000 books. Estimate eight (8) books per lineal foot of shelving. Allow additional special sections of shelving for magazines, newspapers, etc.

4. Audio-Visual Material and Equipment

Each library shall have space for audio-visual material and equipment unless provided for otherwise.

5. Sight Control

The Librarian must have sight control of the entire library from any location within the library.

3.105 CAFETERIAS

1. Determining Space Needs

Determine space needs for dining area in cafeteria by finding ½ of 80% of total estimated enrollment. Multiply ½ of the 80% by 10 square feet to determine necessary space in dining area. This is exclusive of the stage which may or may not be provided.

2. Future Enlargement

The cafeteria should be sized to accommodate the maximum future anticipated enrollment of the school. If not, it must be designed and properly located for future enlargement.

3. Drinking Fountain

An electric drinking fountain shall be provided in the dining area.

4. Building Code Requirements

If the capacity of the cafeteria is 75 or more, the area must meet the requirements of the southern standard building code for Group E - Assembly Occupancy.

3.106 KITCHENS

1. Plans and Specifications

   Kitchen equipment plans and specifications must be submitted for approval with final plans and specifications.

2. Size of Kitchen

   A kitchen of sufficient area to accommodate the equipment necessary to prepare and serve meals for the school lunch program shall be provided. Necessary service areas such as food storage, cleaning supply storage, garbage and can washing facilities shall be provided.

3. Future Enlargement

   The kitchen should be sized to accommodate the maximum future anticipated enrollment of the school. If not, it must be designed and properly located for future enlargement.

3.107 ENTRANCES AND CORRIDORS

1. At least one primary entrance to each building shall be usable by individuals in wheelchairs. Provide a non-slip ramp with a slope not to exceed 1 foot in 12 feet.
2. The floor on the inside and outside of the ramped entrance for wheelchairs shall be level for a distance of 5 feet from the door in the direction the door swings and shall extend 1 foot beyond each side of the door.
3. The minimum width of all corridors shall be 8 feet in the clear.
4. Exit Doors:
   a. Maximum recess of exit doors other than the main entrance shall be 6 feet.
   b. Doors shall have a clear opening of no less than 32 inches when open and shall be operable by a single effort.
   c. All exit doors shall be provided with panic hardware and automatic door closers.

3.108 TOILET ROOMS

1. All toilet rooms shall have a door with automatic closer.
2. A hose bibb and floor drain shall be provided.
3. Privacy shall be insured by providing the proper shielding at doors as necessary.
4. All student toilet rooms shall be provided with a bookshelf.
5. Mirrors in student toilet rooms shall be located other than over the lavatories.
6. All walls and floors must be of ceramic tile, structural glazed tile or other approved easily cleanable material.
7. Tissue holders, soap dispensers, lavatories, etc. must have secure anchorage.
8. Student toilet stall partitions shall be reinforced block walls faced with ceramic tile, marble or other approved finish or reinforced structural tile with a glazed finish. Toilet stall doors may be of metal or other approved material. Marble stalls are o.k.
9. Toilet rooms shall have at least one toilet stall for each sex that:
   (a) Is three feet wide
   (b) Is at least 4 feet 8 inches, preferably 5 feet deep.
   (c) Has a door that is 32 inches wide and swings out.
   (d) Has handrails on each side, 33 inches high and parallel to the floor, 1½ inches in outside diameter, with 1½ inches clearance between rail and wall, and fastened securely at ends and center.
   (e) Has a water closet with the seat 20 inches from the floor.

CHAPTER IV

DESIGN AND CONSTRUCTION STANDARDS RELATING TO HEATING, AIR CONDITIONING AND VENTILATING

4.100 A. General

1. The Southern Standard Building Code and codes referred therein, and applicable local codes shall govern the design and construction standards relating to heating, air conditioning and ventilating when they are more stringent than these regulations.

4.101 B. Design Conditions

1. The maximum outdoor design temperature for heating should be 0^{o} for the Piedmont and $+5^{o}$ for the Coastal Plain area of the State.
2. Consideration should be given in selection of boiler to include future additions.
3. For heating indoor spaces normally occupied by people the indoor heated temperature shall be 72^{o} F.
4. For cooling, indoor conditions shall be as required for average conditions by the American Society of Heating-Refrigeration-Air Conditioning Engineers Guide.
5. Design conditions shall be stated on the plans and/or specifications. All heating and air conditioning plants shall be of adequate size to accommodate maximum design capacity of the building.
6. When unit ventilators and other types of forced air handling (Heating, Air Conditioning or Ventilating) units are used 7½ CFM outside air per person shall be provided with a minimum of 30 CFM total air circulated per person during all times of occupancy.

7. When windows in a space do not have a ventilating area at least equal to 10% of the floor area of that space, mechanical ventilation must be provided to furnish a confortable and healthful environment.

8. All toilet rooms, regardless of the presence of windows, must be provided with ventilating equipment that will provide a minimum of 10 air changes per hour. Duct work for this ventilation must be independent of the main building duct work.

9. The seal of the engineer responsible for the design must be placed on each plan. The engineer must be registered in the State of South Carolina.

4.102 C. Boilers and Boiler Clearance

1. All boilers, accessories, and trim shall be in accordance with the A. S. M. E. Boiler Code.

2. Boiler Clearances

   a. There should be at least two feet clearance on all sides and on top of all boilers.

   b. All steel boilers should have a clearance of 12" plus the length of the longest tube at the front and/or the rear of the boiler for tube removal and replacement.

4.103 D. Boiler Accessories

1. Each boiler shall be equipped with a safety and/or relief valve having an ASME rating specified.

2. When sections are added to a cast iron boiler, the name plate and safety valve shall be changed to comply with the new rating.

3. Safety valve and relief valve discharge lines shall be installed in accordance with the ASHRAE Guide.

4. Install copper test wire on the boiler safety valve in accordance with applicable code.

5. Manholes, rodholes, name plate and ASME stamping shall not be covered with insulation.

6. Boiler piping should not restrict the use of smoke hood clean-out doors, manhole openings, handhole openings and plugged openings.

4.104 E. Stacks, Chimneys and Breeching

1. Stacks

   a. Clean-out openings should be provided at the base of each stack, except those stacks attached directly to the appliance.

   b. Stacks attached directly to the appliance shall be adequately supported other than by the appliance.

   c. Stacks should be adequately braced to hold the stack securely in the center of any thimble through which it passes.

   d. No stack should be nearer than 24" in any direction from a wall opening, exit or fire escape.

2. Chimneys

   a. Masonry chimneys and metal smokestack should extend at least three feet (3') above the highest point where they pass through the roof of the building when equipped with mechanical draft inducers. They shall extend at least two feet (2') higher than any ridge, peak, or wall within thirty feet (30') when not equipped with a mechanical draft inducer.

b. A hinged clean-out door should be installed at the base of each masonry chimney.

c. A flue lining or fire brick lining must be installed the complete length of all masonry chimneys.

d. A precast flue thimble or fire brick lining is required for the breeching opening in the chimney.

3. Breeching

a. Breeching shall be supported independently of the fuel burning equipment

b. Breeching should have easily accessible clean-outs.

c. Discharge breeching from an induced draft fan shall be the same size as the induced draft fan discharge opening.

d. Induced draft fans, when used, should be supported independently of the breeching.

4.105 F. Mechanical or Boiler Room

1. The mechanical or boiler room shall be sized to allow adequate clearance around equipment for servicing and/or replacement. All heating equipment rooms must be separated from occupied parts of the building by construction having a fire resistance of two hours. No door will be permitted to open from a heating equipment room into the occupied portion of a building. The only doors to heating equipment must open to outside and doors shall be of size to allow removal of boiler or other equipment. Equipment rooms must be located so that service trucks may be driven to the equipment room door.

2. Adequate free combustion and ventilation air from outside of building shall be provided for each boiler room. One

square inch of free area should be provided for each 1000 BTU input to the boiler. It is desirable to have one opening near the floor and another near the ceiling.

3. Boiler room floors shall be above finish grade sufficient to resist flooding.
4. Each piece of equipment installed in a mechanical or boiler room should be provided with a concrete base at least 3" thick.
5. All piping, control lines and other appurtenances must be securely supported and/or anchored to prevent damage.
6. A wall hung fire extinguisher of sufficient size and proper type must be conveniently located near the door of the boiler room.
7. Each valve or control must be tagged for easy identification. Tag must be of a permanent type of material and attached by means of wire, rivets, etc. No cord attachments allowed.
8. The engineer designing under this section shall coordinate his work with the architect and other engineers. He shall see that the boiler room is provided with the following properly located to his satisfaction:
   a. At least one floor drain
   b. At least one polarized electric outlet
   c. At least one hose bib
   d. Proper lighting

4.106 G. Fuel Storage

1. Tanks

   a. Fuel storage tanks shall be of such size as to enable owner to purchase fuel in highway tanker lots. Minimum

size to be 7500 gallons.

b. Coal storage shall be of such size as to enable owner to purchase fuel in rail car lots of a minimum of 50 tons.

4.107 H. Operating and Maintenance Instructions

1. Adequate printed instructions, along with schematic diagrams, must be installed in the boiler room. The material shall be mounted in a glass covered, dustproof frame and securely attached to the wall.

2. Owner shall be furnished two bound copies of all mechanical equipment operating and maintenance instructions as issued by the manufacturer.

3. The school custodian shall be thoroughly instructed in the operation and maintenance of each piece of equipment by the manufacturer's representative and/or the mechanical contractor, under the supervision of the mechanical engineer. A signed certificate to this effect shall be furnished the architect and engineer. Special attention is to be given to the maintenance procedure and time sequence. Personnel are to be thoroughly instructed as to location of all grease fittings and other maintenance points. Owner is to be furnished one each of any special tools or equipment needed to perform general maintenance on any piece of equipment.

4. The mechanical contractor shall display in a prominent location in the equipment room, his name, address and phone number for service calls.

4.108 I. Guarantees and Warrantees

1. The engineer under this section shall guarantee that all

equipment shall perform to the standards required by these specifications and the applicable codes.

2. The contractor under this section shall guarantee all materials, equipment and workmanship against defects of any nature and shall guarantee the capacity and quality of all equipment installed by him to meet the ratings specified by the engineer in his plans and specifications. He shall guarantee the installation to be quiet and efficient in operation.
3. The above guarantees shall run from the date of final acceptance of the completed work for a period of one calendar year. Upon notice from the architect or engineer this contractor shall promptly adjust the system, replace defective equipment or materials, check operation, etc., without extra charge.
4. All guarantees or warrantees of equipment manufacturers must be properly endorsed, when endorsement is required, and furnished to the owner. The engineer is to check such documents before delivery is made to owner.
5. The mechanical engineer shall give a letter to the architect, owner, and the Division of Schoolhouse Building, Planning, and Transportation of the South Carolina State Department of Education, stating that the work of his design was installed according to plans and specifications and that he has inspected and approved the installation.

4.109 J. Inspection

All piping, ductwork, etc. must be inspected by the designing engineer or his representative before it is concealed to ascertain its conformance with plans, specifications and applicable codes.

4.110 K. Service Calls

The mechanical contractor shall display, in a prominent location in the boiler room, his name, address and phone number for service calls.

CHAPTER V

ELECTRICAL

5.100 RESPONSIBILITY OF DESIGN

A. The Division of Schoolhouse Building, Planning and Transportation, State Department of Education, does not assume responsibility for electrical design.

B. All electrical design must be prepared by an electrical engineer registered in the State of South Carolina.

C. The electrical plans must bear the seal of the engineer responsible for the design.

5.101 MATERIAL AND WORKMANSHIP:

A. The wire, fixtures, panels, materials, installation and workmanship must meet the requirements of the National Electric Code and all local codes applicable.

B. For all conditions not covered by these regulations, electrical codes or local codes, the Illuminating Engineering Society Lighting Handbook shall be followed.

5.102 MINIMUM LEVELS OF ILLUMINATION:

Area	Footcandles on Tasks
Art Rooms	70
Auditoriums	
a. Assembly only	15
b. Exhibitions	30
c. Social Activities	5
Cafeterias	50
Classrooms	70
Corridors and Stairways	20

Area	Footcandles on Tasks
Drafting Rooms	100
Home Economics Rooms	
a. Sewing	150
b. Cooking	50
c. Ironing	50
d. Sink Activities	70
e. Note-taking Areas	70
Kitchens	70
Laboratories	100
Lecture Rooms	
a. Audience Area	70
b. Demonstration Area	150
Library	
a. Reading Room	
Study and Notes	70
Ordinary Reading	30
b. Stacks	30
c. Book Repair and Binding	50
d. Cataloging	70
e. Card Files	70
f. Check-in and Check-out Desks	70
Music Rooms	
a. Simple Scores	30
b. Advanced Scores	70
Shops	100

Area	Footcandles on Tasks
Sight-Saving Rooms	150
Study Halls	70
Toilets and Wash Rooms	30
Typing	70

5.103 FIRE ALARM:

A. Fire alarm systems shall be non-code, non-supervised, continuous ringing, open circuit, wired type, with drill switch in the office area. These systems must be used in each school building of four (4) or more rooms. Code signal shall not be used.

B. Pull boxes for sounding the alarm must be conveniently located near the administrator's office and in each wing, boiler room, and kitchen. The fire horn must have sufficient volume to be heard in all areas of the school plant. The fire alarm system must be on circuit before the main switch.

C. Pull box must be forty-eight (48) inches from the floor.

5.104 PANEL DIRECTORY

A. All electrical panels shall have typed directory mounted therein.

5.105 EXIT LIGHTS:

A. Exit signs, as required by the Southern Standard Building Code, shall be properly located. Signs must be illuminated at all times the building is occupied.

B. Circuits for all exit lights shall be independent of all other light or equipment circuits.

C. Each exit light shall be equipped with two lamps. These lamps shall

be supplied from separate circuits.

5.106 LIGHT FIXTURES:

A. All fluorescent fixtures are to have self-protected ballasts, or be protected by an enclosed fuse -- Bus Type H - in primary.

5.107 CONVENIENCE OUTLETS:

A. A minimum of one duplex convenience outlet shall be provided in each end wall of all classrooms, and other instructional spaces. These shall be located eighteen (18) inches above the floor, unless otherwise specified.

B. Care shall be exercised to provide additional outlets for use of special purpose equipment or fixtures in all spaces of the building.

5.108 ENGINEERS STATEMENT OF INSPECTION:

A. The designing engineer must state in writing that the job is installed in accordance with his plans and specifications.

B. A copy of the statement must be sent to the architect, owner, and the Division of Schoolhouse Building, Planning and Transportation, State Department of Education.

CHAPTER VI

6.100 Codes and Regulations

1. All plumbing to comply with the following:
    a. The Plumbing Section of the Southern Standard Building Code.
    b. Any local codes having jurisdiction.
    c. Regulations of the S. C. State Board of Health.
    d. Applicable provisions of Act Number 174, 1963 Code, State of South Carolina, pertaining to facilties for handicapped persons, a copy of which may be obtained from the Division of Schoolhouse Building, planning and Transportation.
2. Where more than one code or regulation is applicable, the most stringent one shall govern.

6.101 Working Heights

1. The working heights listed on page 3 are to be used, unless they are contradictory to any applicable codes or regulations as set forth under paragraph 6.100 above.
2. Some of these working heights directly affect the work of the engineer. Others, he will find useful. --Example, the working height of a base cabinet for home economics is 3'-0". This information will be of assistance in selecting sinks, garbage disposal units, etc. that may be required to be mounted in the cabinet.

6.102 Water Supply and Sewage Disposal

1. The engineer shall ascertain before commencing his design, as to the type water supply and sewage disposal systems that the South Carolina State Board of Health will approve for the particular project.
2. Water supply shall be from one of the following:
   a. Water from a public system, if it is accessible, technically and economically feasible.
   b. On site well, only after public supply is found to be unfeasible.
3. Sewage disposal shall be by one of the following:
   a. Discharge into a public system, if accessible, technically and economically feasible.
   b. On site lagoon, treatment plant, or septic tank (One of these methods to be used only after public system is found unfeasible after careful investigation).

6.103 Lunchrooms and Cafeterias

1. Special attention shall be given by this engineer to the requirements of the South Carolina State Board of Health Regulations that pertain to food handling, storage, preparation, and serving. He will be concerned with hot water temperature, water volume, dishwashing machines and other special purpose facilities.

6.104 WORKING HEIGHTS FOR SCHOOL FIXTURES AND EQUIPMENT

ITEM	Grades 1-3	Grades 4-6	Grades 7-12	Adm.& Public
Plumbing Fixtures:				
Lavatories	2' 1"	2' 4"	2' 6"	2' 7"
Lavatories for Handicapped	Allow for wheel chair to go under			
Urinals (Rim)	1' 6"	1' 8"	1' 10"	2' 0"
Urinals for Handicapped	Rim 19" above floor			
Drinking Ftn. (Nozzle)	2' 2"	2' 4"	2' 8"	3' 0"
Drinking Ftn. for Handicapped	Floor mounted 2' 6"; wall 3'0"			
Toilet Room Accessories:				
Paper Towel Dispenser	3' 6"	4' 0"	4' 6"	5' 0"
Paper Towel Dispenser for Handicapped	2' 8" above floor			
Toiler Paper Holder	2' 1"	2' 4"	2' 4"	2' 6"
Soap Dispenser	6" above lavatory heights			
Mirrors (Bottom)	3' 0"	3' 3"	3' 9"	4' 0"
Mirror - Shelf (No mirrors over lavatory)	2' 6"	2' 9"	3' 3"	3' 6"
Mirror for Handicapped	2' 8" above floor			
Water Closets	13"	13"	15"	15"
Water Closets for Handicapped	Seat 20" above floor			
Work and Sink Counters	2' 1"	2' 4"	2' 8"	3' 0"
Chalk Boards (Bottom)	2' 2"	2' 4"	2' 6"	____
Width of all Chalk Boards	3' 6"	3' 6"	3' 6"	____
Clothes Rods and Hooks	3' 6"	4' 0"	5' 0"	____
Hat Shelf	3" above clothes pole or hooks			

ITEM	Grades 1-3	Grades 4-6	Grades 7-12	Adm.& Public
Library and Book Shelves:				
Maximum Top Height	5' 0"	5' 0"	6' 10"	6' 10"
Shelves (Book)	8" wide throughout the school			
Shelves (Magazine)	10" to 12" wide throughout school			
Shelves (Reference and Picture Books)	10" wide throughout the school			
Library Work Room Cabinet (Provide Space to sit at work)	32"	32"	32"	____
Home Economics:				
Base Cabinets			3' 0"	
Wall Cabinets			4' 4" Bottom 6' 10" Top	
Cafeteria:				
Cafeteria Work Counters	3' 0"	3' 0"	3' 0"	
Cafeteria Soiled Dish Window	4' (50-350 pupils)		6' 0" (350-1000)	
Shop Work Bench	—	—	2' 8"	

Notes: 1. All heights are from finish floor.

2. Use heights of grades 4 - 6 where common facilities are provided throughout the plant.

CHAPTER VII

FEDERAL AID PROJECTS UNDER PUBLIC LAW 89-10, TITLE I

7.100 Wage Determination and Labor Standards Forms

1. Must be included in the specifications, general contract and all sub-contracts for the project when the amount of Federal Aid is in excess of $2,000.00.
   a. Exception to this regulation is made when all of the work of the project is to be performed by regular salaried employees of the school district.
2. Must be posted on each site at all times until completion of the project.
3. The office of Schoolhouse Building, Planning and Transportation of the State Department of Education will furnish, upon request of architects or school administrators, three copies of Form DB-11 for each project. Form DB-11 is used to apply for Wage Determination and Labor Standards forms.
   a. Original and one copy should be returned to this office being completed. The second copy must be retained in the files of the local school administrator.
   b. Completed Form DB-11 will be forwarded by this office to Washington. Upon receipt of Wage Determination and Labor Standards forms this office will forward them to the local school administrator or architect, as requested. Allow six weeks from date of returning the completed DB-11 form to this office until the Wage Determination and Labor Standards forms reach you.
   c. Wage Determinations expire after a period of 120 days. The

project must be under contract before the expiration period of the Wage Determination. Timing and coordination are important in order to avoid the attendant delay in obtaining new Wage Determination.

(1) Send completed Form DB-11 to this office at a time so that the Wage Determination should be in the hands of the architect for use in compiling his specifications. The plans and specifications should be complete before requesting final approval of this office prior to advertising.

4. When Federal funds, in excess of $2000.00, are to be used on a project, the "advertisement for bids" must state that:
"This project is financed in whole or in part by Federal funds and the project will be subject to the Wage Determinations and Labor Standards as required by the Federal Government, a copy of which will be made part of the contract documents."

a. A copy of the "advertisement for bids" must be included in the bidding material submitted to contractors.

7.101 Liquidated Damages Clause

1. Below is quoted the directive of the Office of Education of the U. S. Department of Health, Education and Welfare that must be complied with:

a. "Each contract for construction for a project under Title I of the Act entered into by a State or local educational agency shall provide for the payment to the State or local agency of liquidated damages in the event of a failure by the contractor to complete the construction work in timely fashion. All such liquidated damages received by the State or local educational agency shall be credited against the cost of the project."

APPLICATION FOR APPROVAL OF FINAL PLANS AND SPECIFICATIONS

The undersigned hereby applies for approval of the final plans and specifications described herein:

School_____ Pupil Capacity of Proposed Facility_____

Street_____Community_____County_____

(Check one) New School___Addition___Alterations___Additions and Alterations_____

Type Facility (check one) Kindergarten___Elementary___Jr. High___High School___K-12_____

ESTIMATED COST:

Area_____square feet
(Figure open covered corridor as 1/3)

Est. cost/sq. foot $_____
(Use "A" total for calculation)

SOURCE OF FUNDS:

Local $. . . . . .

State $. . . . . .

Federal $. . . . . .

TOTAL- - $. . . . . .

	General Construction	$. . . . .
	Mechanical	. . . . .
A.	Total	$. . . . .
	Site development	$. . . . .
	Equipment	. . . . .
B.	Total	$. . . . .
	Arch. & Eng. Fees	$. . . . .
	Legal and Adm.	. . . . .
	Contingencies	. . . . .
C.	Total	$. . . . .
	GRAND TOTAL- - - - - -	$. . . . .

The engineers who have prepared the following portions of the work and their license numbers are:

Structural_____No._____
Mechanical_____No._____
Electrical_____No._____

The duly established Building Committee is:

_____Chairman_____Secretary
_____Member_____Member
_____Member_____Superintendent of Schools

I certify the Plans and Specifications described above were approved by the Building Committee on
_____Date_____Chairman or Secretary

I certify the Plans and Specifications described above were approved by the Board of Education on
_____Date_____Superintendent of Schools

I certify that the Plans and Specifications described above have been prepared by me and are to the best of my knowledge in accordance with the current South Carolina State School Building Code and other regulations as accepted by the Schoolhouse Building & Planning Section of the State Department of Education.

Firm Name_____Architect (s)

By_____Architect ... License No._____

TENTATIVE SPECIFICATIONS TO BE SUBMITTED WITH ALL PRELIMINARY SCHOOL PLANS

County _____ Name of School _____

District _____ Enrollment _____ Area Sq. Ft. (New) _____

FOUNDATION:

Continuous concrete footing _____ Other _____

SUPERSTRUCTURE:

Concrete _____ Brick & Block _____ Other _____

ROOF:

Built-up ____ Composition shingle _____ Other _____

GROUNDS:

Area fenced _____ Graded and drained _____ Seeded _____

Shrubbed _____ Athletic field _____ Hard surfaced walks _____

Hard surfaced drives _____ Hard surfaced parking lots _____

Flag pole _____ Other _____

HEATING & VENTILATING:

Fuel: Coal ____ Oil ____ Electricity ____ Other _____

Type: Steam ____ Hot water ____ Hot air ____ Other _____

Units: Radiators ____ Convectors ____ Unit Ventilators ____ Unit blowers ___

Space heaters ____ Other _____

Lunch Room Cooking Fuel: Gas ___ Oil ___ Electricity ___ Other _____

Ventilating: Mechanical _____ Air Conditioning _____

Roof Vents provided: Toilet rooms ___ Kitchen range ____ Janitor's closet ____

Boiler room ___ Dry Food storage ___ Other _____

Electrical: Service enters building by: Overhead wire ___ Underground wire ____

Receptacles provided in: All classrooms _____ Corridors _____

Special Lighting: Exit markers __ Outside lights __ Stage __ Other _____

Foot candle intensity provided: Classrooms____ Library____ Stairways _____

Drafting room _____ Other _____

PLUMBING:

Fixtures: Give number of each: Drinking fountains _____ Lavatories _____

Showers ____ Urinals _____ Flush toilets ____ Service sinks _____

Other _____

Hot and Cold water provided in: Toilets ____ Showers ____ Kitchen _____

Laboratory type classrooms ____ Other _____

Hose Bib and Floor Drain: Toilet rooms (required) _____

Shower rooms ____ Kitchen ____

Sill Cocks: Provided for outside usage _____

Gas: Master valve, convenient for teacher control, provided in all laboratory rooms where gas is available for student use _____.

MATERIAL USAGE:

Doors:

Exterior: Metal ___ Wood ___ With closures ___ With panic hardware ___

Classrooms: metal ___ Wood ___ Size of glass panel _____

Toilet Rooms: Metal ___ Wood ___ With door closures _____

Windows:

Steel sash ___ Aluminum sash ___ Wood sash ___ Percent of window area operable for ventilation___

Interior Surfaces: List Materials to be Used;

NO. OF SPACES	FLOORS	WAINSCOT	CEILING	WALLS
_____ Classrooms				
_____ Corridors				
_____ Kitchen				
_____ Library				
_____ Lunch Room				
_____ Music				
_____ Multi-purpose				
_____ Offices				
_____ Showers				
_____ Stairways				
_____ Toilet				

SPECIAL FEATURE:

SYSTEM	CONDUIT ONLY	CONDUIT AND WIRING	COMPLETE WITH EQUIPMENT
Bell			
Clock			
Fire Alarm			
Public Address			
Telephone			
Television			

WATER DISPOSAL-PLUMBING:

Source of Water Supply: Municipal _____ Other _____

(If "Other" give source: _____

Disposal System: Public sewer _____ Other _____

(If "Other" give source: _____

List below other features related to this project such as Special Rooms, Provisions for future expansion, Play Areas, Covered Walks, Services Provided in other buildings on this site, etc.:

Date: _____

Architect's Signature: _____

(NOTE: This form may be reproduced)

RULES AND REGULATIONS OF THE S. C. STATE BOARD OF HEALTH RELATING TO THE SANITATION OF SCHOOLS

The following rules and regulations can best be met during the planning of new and renovation of existing school buildings rather than after completion of a building or renovation plans.

SECTION 1. Definitions.

(a) The term "school" as used in these regulations shall include all elementary, junior high, and high schools in the State of South Carolina.

(b) The term "school building" as used in these regulations shall include all buildings operated for the use of the students, teachers, and patrons of the school.

(c) The term "classroom" as used in these regulations shall include all rooms in which classes are held or are used for studying.

(d) "Adequate facilities" shall be based on an average classroom load of not over 30 pupils in elementary grades and not over 25 pupils in junior high and high schools. Laboratories, libraries, home economics rooms, storage rooms or rooms of similar usage, will not be used in this computation.

(e) The term "Health Officer" shall mean the health authority of the cities and/or counties and/or the State, or his authorized representative.

SECTION 2. Plans and Specifications.

(a) No school board of trustees (or any other responsible group should this term not apply) shall build any school building, secure any building for school purposes, or make any additions or major changes in a school building, or enter into contract for such construction until complete plans and specifications for Sections 3, 4, and 5, as outlined in these regulations, have received the written approval of the S. C. State Board of Health, and thereafter such plans must be substantially adhered to unless proposed deviations receive the written approval of the S. C. State Board of Health prior to letting of bids for any construction or installation of equipment.

(b) All Plans and specifications shall be prepared by a professional architect licensed to practice in the State of South Carolina.

(c) Plumbing and mechanical portions of all plans and specifications referred to in Paragraphs (a) and (b) of this Section shall bear the seal and signature of a professional engineer, registered in the State of South Carolina.

(d) Properly prepared plans and specifications for construction, remodeling, or alteration of existing structures for use as a school lunch unit, showing layout, arrangement, construction materials, finishes of work areas, and the location, size, and type of fixed equipment and facilities, shall be submitted to the State Board of Health for approval. This approval must be received by the architect before such plans and specifications are released to the proper school authorities.

(e) One complete set of plans and specifications plus one additional copy of the plumbing, mechanical, and the above mentioned kitchen equipment layout plans and specifications, shall be submitted to the State Board of Health for approval.

(f) Sections 3, 4, and 5 cover items which will be reviewed on the plans and specifications for compliance by the Division of Sanitary Engineering and approval shall be granted for construction, if so merited. The local health department representatives shall be responsible for inspection of these items during and after construction and/or renovation of the school to ascertain that there are no unauthorized deviations to the approved plans and specifications.

SECTION 3. Plumbing.

Item 1. Toilet Rooms.

At least one (1) toilet room for each sex must be provided on each floor level and must be well lighted, protected from flies, ventilated to the outside air or to an independent ventilation system (positive mechanical ventilation is recommended) and reasonably acoustically insulated. Floors and walls shall be of easily cleanable construction. "Gang" toilet rooms shall be equipped with floor drains and at least one hose bibb. An individual toilet room is recommended for primary grade classrooms. Paper towel and soap dispensers shall be furnished to all lavatory locations. Sanitary napkin containers shall be provided in junior high and high school girls' toilet rooms and sanitary napkin dispensers are highly recommended.

Item 2. Facilities.

(a) Drinking Fountains: Drinking fountains shall be furnished in all schools on the basis of not less than one (1) to every one hundred (100) pupils with at least one on each floor level. They shall be so made that the stream is from a free jet projected at an angle to the vertical, and have a guard to prevent the mouth being placed directly against the orifice. There shall be no possibility of the orifice becoming submerged. The use of the common drinking cup is forbidden. Mechanically-refrigerated drinking fountains are strongly recommended.

(b) Lavatories: Adequate lavatories or basins, conveniently located, shall be provided as follows in order of preference:

(1) One (1) lavatory in each classroom plus two (2) in each gang toilet; or

(2) One (1) lavatory in each gang toilet for every two (2) water closets or fraction thereof, plus one (1) for every three (3) urinals.

(3) Gang lavatories, if proposed, will be approved on the basis of the above requirements with 18 inches (18") of length being considered equal to one (1) single lavatory.

It is recommended that mirrors be placed in some accessible location other than over the lavatories.

(c) Water Closets and Urinals: Minimum toilet facilities shall be provided on the following basis:

One (1) urinal for every thirty (30) boys, in addition to water closet requirements in all schools. Trough urinals will not be acceptable on any basis. Installation of urinals for girls' usage shall be prohibited.

Elementary Schools:

One (1) water closet for every thirty (30) girls.

One (1) water closet for every sixty (60) boys.

High and Junior High Schools:

One (1) water closet for every forty-five (45) girls.

One (1) water closet for every ninety (90) boys.

If Grades 1 through 12 are housed in the same building, the schedule for elementary pupils shall prevail. In all schoolhouses hereafter constructed, rehabilitate modernized, or to which additions are made, toilet seats shall be of open-front type and toilet bowls of elongated front design. Toilets shall be of the flush type. Toilet paper dispensers shall be supplied for each unit.

Item 3. Sewage Disposal.

School sewage effluent shall discharge into a municipal sewerage system or other system approved by the State Health Officer. Approval of the latter shall be based o current State Board of Health rules and regulations governing sewage disposal. Schoo sewerage systems shall be based on present needs and reasonable future requirements.

Item 4. Sewage Collection System.

In general, plumbing shall conform to the basic principles as set forth in the American Standard National Plumbing Code. Local plumbing codes shall prevail should they prove more stringent. Particular attention will be focused during the review on the following and approval granted on the basis noted.

(a) All drains beneath buildings and to a point five (5') feet from the building shall be of cast iron soil pipe. Extra heavy cast iron shall be used where the building exceeds one story in height, and under all drives and walkways.

(b) Horizontal drainage piping of 3-inch diameter or less shall be installed with a fall of not less than ¼ inch per foot.

(c) Horizontal drainage piping 4 and 5 inches in diameter shall be installed w a fall of not less than 1/8 inch per foot. Larger piping shall be laid on a slope a required for the building sewer in (d), below.

(d) The building sewer shall be laid on a slope sufficient to assure a compute effluent velocity of not less than 2 feet per second with the pipe assumed flowing full or half-full (Kutter's formula). The velocity should not exceed 10 feet per se ond in vitrified clay, concrete, bituminized fiber, or asbestos cement sewer pipe. All pertinent invert elevations must be furnished on the plans.

(e) Fittings, venting, materials, joints, traps, cleanouts, backwater valves, hangers, and supports shall meet the minimum requirements as set forth in the National Plumbing Code.

(f) Acid-resistant pipe shall be used in connection with liquid wastes from physics, chemistry and other laboratories where harmful chemicals might injure or destroy a common type sewer. These pipes may not be connected to the main building sewer except at a point where it is assured that the normal flow in the sewer is such that dilution will neutralize these chemicals to a non-injurious level.

Item 5. Water Supply and Distribution System.

(a) The source of water supply shall be by connection to a municipal, or other approved, water system. Should this connection not be practical, a separate water system shall be installed on the school property. Water from this system must meet all bacteriological, physical, and chemical requirements as set forth in current U. S. Public Health Service Drinking Water Standards. Plans and specifications shall thoroughly cover this proposed installation so that determination may be made as to good engineering and public health practices. The system shall be designed to provide a minimum of 30 gallons per day per student.

(b) The entire water piping system, in general, shall conform to standards as outlined in the American Standard National Plumbing Code. Local plumbing codes shall prevail should they prove more stringent.

(c) All joining of pipes of dissimilar metals shall be made with an insulating connection.

(d) The water system, including hot water piping, shall be filled with a solution containing 50 ppm of available chlorine and allowed to stand six (6) hours before flushing. After chlorine has been completely flushed from the system, the engineer shall contact the local health department whose representative shall then take at least three (3) random bacteriological samples. These shall be submitted to an approved laboratory to determine efficiency of the disinfection process.

Should any of the three reports prove unfavorable, the entire disinfection and sampling process shall be repeated. The local responsible health agency shall retain a copy of these bacteriological reports.

(e) All plastic pipe shall bear the NSF (National Sanitation Foundation) seal of approval.

SECTION 4. Kitchen and Lunchrooms.

Item 1. Plumbing.

(a) Kitchen and lunchroom plumbing shall conform to all requirements set forth in Section 3, above.

(b) Floor drains must be provided adjacent to the dishwashing area, adjacent to and outside the walk-in cooler door, at the vegetable peeler, and at other pertinent locations in the kitchen, with floor graded to drains.

(c) At least one hose bibb with mixing valve shall be provided within the kitche area. A threaded faucet on a service sink will meet this requirement.

(d) At least one (1) lavatory, as well as service sink, both equipped with a 140 and cold water mixing valve, shall be provided in the working area of the kitchen.

Item 2. Dishwashing Facilities.

(a) Dishwashing facilities in new schools shall be provided on the following bas

Enrollment	Up to 250	250 to 500	500 to 1000	1000 up
Dishwashing Method	3-Compartment Sink or Timed Automatic Door Type Dishwasher	Timed Automatic Door Type Dishwasher	Conveyor Type 1-Tank Automatic Dishwasher	Conveyor Type 2-Tank Automatic Dishwasher

It is strongly recommended that reasonable future projections be considered before sizing the dishwasher.

(b) Dishwashing facilities shall be re-evaluated and provided in accordance wit the schedule in Item 2 (a), above, in any existing school where an addition is propos The actual average participation figure, as shown on records of the State

Lunchroom Supervisor, plus the proposed addition load (Section 1 (d)), shall be the basis of dishwashing sizing.

(c) Dishwashing machines must bear the National Sanitation Foundation (NSF) seal of approval and meet all current State Board of Health criteria.

(d) A thermostatically-controlled heating element, capable of assuring a continuous reading of 150° F in the wash water tank, shall be a required component of the dishwasher.

(e) Dishwashing machines must be equipped with fittings for use in checking manifold temperature and pressure.

(f) All dishwashing machines must be equipped with pressure gauge and thermometer where water pipe enters the rinse manifold.

Item 3. Heated Water Supply.

(a) Kitchen hot water shall be furnished on a basis of 1.4 gallons per pupil per meal.

(b) The 140° F hot water generating system shall be engineered to meet the maximum for the following distribution:

(1) 28% to be used during food preparation period

(2) 55% to be used during the dishwashing period

(3) 17% to be used during the cleanup period.

(c) The dishwashing period ((b) (2)), above, shall be based on the time required for the particular dishwasher specified to wash four (4) utensils per person participating with an assumed operating efficiency of 70%. This period shall be a minimum of 2 hours if a 3-compartment sink is allowed.

(d) Booster heaters, if used to obtain 180° F water for automatic dishwashers, shall have a pressure-reducing valve and shock absorbing fitting to dishwasher instal in the influent line to dishwasher. The water supply line to the booster shall provide water with a pressure of at least 20 psi. The booster heater shall be adjacent to the dishwasher.

(e) If the hot water generating system is installed more than 25 feet from the

dishwasher, a return line with recirculating pump must be installed. This would be the 140° F line if a booster is installed, and the 180° F line if only 180° F water is generated and general purpose 140° F water is furnished by a mixing valve arrangement. Exposed piping shall be color coded for ease in tracing.

(f) If a 3-compartment sink is allowed in accordance with regulations on participation, disinfection shall be by one of the methods outlined in the Rules and Regulations Governing Food Service.

(g) Separate hot water generating and distribution systems shall be provided hereafter for new school kitchens, and also existing kitchens when present hot water heating system is replaced.

(h) In existing schools, where the hot water generating system serves fixtures throughout the school as well as the kitchen, any proposed classroom additions shall be approved to the extent that the total load on the generating system does not exceed the kitchen load requirements given above, plus manufacturer's rating and participation for the remaining fixtures. When these loads exceed the rated capacity of the generating system, hot water systems shall be furnished as in (g), above.

Item 4. Facilities for Kitchen Personnel.

(a) Toilet Rooms: At least one (1) toilet room, equipped with self-closing doors, shall be provided for kitchen help.

(b) Toilet rooms in Item 4 (a), above, shall be equipped with at least one (1) water closet and one (1) lavatory. Both hot and cold water shall be supplied to the lavatory. Plumbing and ventilation must conform to pertinent sections of these regulations.

(c) Dressing area and lockers shall be provided for lunchroom employees.

Item 5. Garbage. Can Wash Area.

(a) A mixing faucet for tempered water shall be installed for use in the can wash area. A drain shall be installed in conjunction with this faucet so that at no time will there be traffic over the flow area from the faucet to the drain. The floor slope to drain shall be at least 1/4 inch, but not more than 5/8 inch per foot.

(b) The can wash drain must discharge into an approved grease trap where septic tank and tile fields are used as the method of sewage disposal.

Item 6. Miscellaneous.

(a) Floats on casters, or dollies, shall be provided on the floor beneath pantry shelving. The minimum distance between the floor and the bottom shelves shall be 18 inches.

(b) Doors shall be provided on the working side of the kitchen serving counters to protect the contents from flies, vermin, and splash.

SECTION 5. Fly, Gnat, and Mosquito Control.

Item 1. Doors.

Outside doors within the entire school plant shall be of the self-closing type. Service doors from the kitchen to the outside shall be installed in a manner, or location, so that screen doors, opening outward, can also be installed. Self-closing jalousied screened doors will be acceptable as a combination.

SECTION 6. Sanitation Requirements for Operating Schools.

All schools shall be inspected at least twice each year by the local health officer for compliance.

Item 1. Floors.

All floors shall be kept in good repair - free from cracks, smooth and cleaned each school day by dustless methods.

Item 2. Walls and Ceilings.

Walls and ceilings shall be kept clean and in good repair.

Item 3. Drinking Fountains.

All drinking fountains shall be maintained in good working order at all times. No common drinking cups shall be used.

Item 4. Water Supply.

(a) The water supply shall be adequate; of a safe, sanitary quality, under pressure at all times, and shall meet all requirements of the State Board of Health

as to drinking water.

(b) No hose shall be allowed to remain attached to the can-wash faucet unless an approved vacuum breaker is properly installed. Lack of a vacuum breaker in a situation of this type would constitute a possible cross connection.

Item 5. Toilet Facilities.

(a) Sufficient potable water under pressure shall be supplied to toilet room facilities at all times.

(b) Toilet tissue shall be provided at all times in proper dispensers conveniently located to the toilet facilities.

(c) All facilities shall be kept clean and in good repair at all times.

(d) Sanitary napkin dispensers are recommended and sanitary napkin containers shall be required in all junior and high school girls' toilet rooms. The latter shall be emptied and cleaned at least once each school day.

(e) All toilet room doors shall be self-closing.

(f) All toilet facility rooms shall be kept clean and neat at all times.

Item 6. Lavatories.

(a) Approved sanitary towels and soap shall be provided convenient to all lavatories or basins at all times.

(b) Lavatories or basins shall be kept clean and in good repair.

Item 7. Sewage.

The sewage disposal systems shall be maintained in a satisfactory condition at all times.

Item 8. Disposal of Waste.

All garbage and refuse shall be stored in tight, approved-type washable receptacles, covered pending removal.

Item 9. Cleanliness of School Building, Premises and Equipment.

All parts of the school building, premises and equipment shall be kept clean at all times.

SECTION 7. School Lunchrooms.

All food service rooms shall meet all the requirements set forth in current South Carolina State Board of Health Rules and Regulations Governing Food Services.

SECTION 8. Enforcement Interpretation.

These regulations are issued under the authority of the Code of Laws of 1962, and subsequent legislation. They shall be enforced by the Health Officer in accordance with interpretations and reasons which shall be provided by the State Board of Health.

SECTION 9. Penalties.

The penalties for violation of these rules and regulations are contained in Section 32 - 17 S. C. Code 1962.

* * * * * * * * * * CERTIFICATION * * * * * * * * * *

I certify that the foregoing rules and regulations of the South Carolina State Board of Health relating to the sanitation of schools in South Carolina, approved the 15th day of January 1964, by the Executive Committee, are hereby declared to be the official rules and regulations of the South Carolina State Board of Health relating to the sanitation of schools in South Carolina, and supersede the Rules and Regulations Relating to School Health, filed in the office of the Secretary of State April 10, 1952. I further certify that said rules and regulations are herewith filed with the Code Commissioner and Secretary of State, under the authority of Title 32, Article 1, Paragraph 32-8, of the 1962 S. C. Code of Laws, on this 2nd of March 1964.

G. S. T. Peeples, M. D. (L. S.)
Secretary of the State Board of Health
and State Health Officer

3/2/64
1/7/65(300)

CREATION OF FALLOUT SHELTERS IN SCHOOL BUILDINGS FOR USE IN SAVING LIVES AS A RESULT OF MAN-MADE DISASTERS (NUCLEAR DETONATIONS) AND/OR NATURAL DISASTERS (TORNADOES, FIRES, FLOODS, ETC.)

A. General

1. Architects and their consulting engineers exert the greatest single influence on building design. Thousands of new buildings, including schools, are being built each year in which the life saving potential could have been increased if attention had been focused on the problem of radiation shielding during the initial design phase. Special knowledge is required to accomplish this -- knowledge of the nature of radioactive fallout and how to design buildings to provide shielding against it.

2. To insure maximum life saving potential in new school buildings, consideration should be given to techniques in slanting design for radiation protection as offered by The Professional Development Services, a function of The University of South Carolina under the sponsorship of The Office of Civil Defense, Department of Defense, Washington, D. C.

B. Professional Development Services

1. What Service?

The Office of Civil Defense Professional Development Services, a means by which architectural and consulting engineering firms may obtain professional advice and guidance in the techniques of providing or increasing public fallout shelter in the designs of new buildings or additions to and remodeling of existing ones.

2. How Do These Techniques Increase Shelter Spaces?

A new building can provide more protection from fallout and/or natural disasters, at little or no additional cost, if the design includes radiation shielding concepts. As more buildings are constructed with fallout protection "designed in", the community shelter space inventory is increased.

3. How Is This Protection "Designed In"?

Through a technique called "slanting" for radiation protection which is merely the incorporation of fallout shelter shielding concepts in designs of new buildings. It can be done by professionals knowledgeable in the techniques of fallout shelter design and analysis. Examples of "slanting" include relocation or reduction of window openings, locating building on site to take advantage of mutual shielding from adjacent structures, providing basements, entrances off-set or protected by baffles, and selection of construction materials having greatest mass. (See Attachments 2 and 3, Technical Memorandum 64-2 and Technical Report 44.)

4. Who Are These Professionals Knowledgeable In Shielding Techniques?

Many architects and consulting engineers have participated in OCD Fallout Shelter Analysis courses and are certified by the Department of Defense as qualified fallout shelter analysts. This is an on-going OCD program, and the Professional Development Service is actually an extension of it. Names of Qualified Fallout Shelter Analysts may be obtained from the South Carolina Civil Defense Agency, Rutledge Building, 1429 Senate Street, Columbia, South Carolina, Attention, Assistant Director (Shelter).

5. What Does The Service Provide?

Basically, it provides an architect or consulting engineer who is also a Fallout Shelter Analyst to assist architectural or engineering firms to incorporate "slanting" techniques in new building design or modification. In the process, the Professional Development Service consultant can advise on methods by which fallout shelter may be attained at little or no additional cost and without adversely affecting appearance or function.

6. Who Are These Analysts With The Professional Development Services?

They are architects and consulting engineers who have completed the OCD graduate-level course. Many of them serve on the faculties of architectural and engineering schools and colleges and are also qualified to teach fallout shelter analysis to other architects and engineers.

7. Who Gets This Professional Development Service?

The shelter program Professional Development Service is available only to architectural and consulting engineering firms. Generally, the service is provided to firms involved in projects still in the preliminary design phase.

8. Specifically, What Do The Advisors Do?

They may carry out the following activities: (a) Conduct one- or two-day seminars, courses, lectures, and on-the-job training sessions on fallout shelter analysis, design, and criteria for architectural and consulting engineering firms, (b) Review building designs to evaluate potential for fallout shelter protection, and recommend "slanting" design techniques, (c) Provide technical guidance concerning analysis and design of buildings to increase shielding protection -- again, using "slanting" techniques where feasible. They <u>DO NOT</u> engage in actual design.

9. When Can School Officials Concerned With New Construction Get Professional Development Service Help?

When school officials and/or representatives of an architectural or consulting engineering firm decide they need the services of an

advisor to assist in the incorporation of fallout shelter shielding concepts in the design of a new school, they can forward the request to the State Civil Defense Agency through the State Department of Education. If all requirements are met, a development consultant is designated by the State Civil Defense Agency to work with the architectural or consulting engineering firm.

10. With What Kinds of Buildings Is The Service Concerned?

All private, industrial, and non-Federal public buildings in which public fallout shelters with a Protection Factor of 40 can be incorporated.

11. What Is Protection Factor 40?

Protection Factor is a term used to express the relation between the amount of fallout gamma radiation that would be received by an unprotected person and the amount that would be received by one in a shelter. The occupant of a shelter with Protection Factor 40 would be exposed to only one-fortieth or 2½% of the radiation to which he would be exposed if his location were unprotected.

12. Can The Development Advisor's Services Be Retained Indefinitely?

No. Except in unusual circumstances, the Professional Development Service is limited to a "one-time only" basis for each firm. Firms which repeatedly require these services may develop their own fallout shelter analysis technical capability by enrolling staff members in on-going courses. Details on fallout shelter analysis courses may be obtained from the State Civil Defense Agency.

13. Who Pays?

The shelter program professional development service advisors are under contract to OCD. There is no charge to the architectural or consulting engineering firm or the client (building owner). Their professional assistance to architectural and engineering firms will result in increased fallout shelter spaces for the community. The dividend is "protection for the people."

14. Is This Service Unique?

Yes, in respectto fallout shelter design. However, it is comparable to the type of specialized assistance provided to architects and consulting engineers by the trade associations. In other words, it does not provide design services but offers advice and guidance on how to achieve fallout protection through the firm's own design efforts.

15. What Action May Be Expected From The Architect?

The approach to the architect's clients or prospective clients will be in terms of pointing out that fallout shelter is good architecture,

and this protection need not adversely affect the cost, function or appearance of the building. The owner may at least incorporate as much protection as possible while still remaining within the original budget allocation.

16. How Can School Officials And Their Architects Concerned With New Construction Request This Service?

By getting in touch with the State Civil Defense Agency through the State Department of Education and filling out a "Request for Professional Development Services" form. (See Attachment 1.)

SUBJECT: Request for Professional Development Services

THRU: State Department of Education
1429 Senate Street
Columbia, South Carolina 29201
Attention: Director, Division of Schoolhouse
Building, Planning and Transporation

TO: South Carolina Civil Defense Agency
1429 Senate Street
Columbia, South Carolina 29201
Attention: Assistant Director (Shelter)

Project:

Location:

Status of Design:

☐ Schematic Design ☐ Design Development ☐ Construction Documents

School Official/Address:

Architect/Address:

Architect's Telephone No.:

Certified Fallout Shelter Analyst on Architect's staff or among his consultants?

☐ Yes ☐ No

School Official ☐ and/or Architect ☐ (Check applicable block/s/) has been advised of availability of professional development services and requests technical advice.

Type of Service Desired:

☐ Advisory ☐ On-the-job Instruction ☐ Review

Project is located in area of shelter deficiency. ☐ Yes ☐ No ☐ Unknown

Estimated Capacity of Shelter Area:

☐ Over 50 ☐ Over 100 ☐ Over 500 ☐ Unknown

Professional development services being requested by School Official and/or Architect:

☐ Initial Request ☐ Second Request ☐ Other

Remarks: (Note: If additional space is required, please attach separate sheet.)

SAMPLE
SAMPLE
SAMPLE

Attachment 1

DEPARTMENT OF THE ARMY
OFFICE OF THE SECRETARY OF THE ARMY
OFFICE OF CIVIL DEFENSE
WASHINGTON, D.C. 20310

Technical Memorandum 64-2
February 1967 *

CREATION OF FALLOUT SHELTER THROUGH SLANTING AND COST REDUCTION TECHNIQUES

Slanting in Design and Construction

Design slanting is defined as the incorporation of certain architectural and engineering features into new structures for little, if any, cost increase to protect personnel from fallout gamma radiation in event of an emergency. The slanting features may provide immediate improvement or may be of such nature as to facilitiate later conversion of the structure for protective purposes. Thus, slanting adds the protective function to the other criteria normally considered in the design of structures.

Every building is a natural shield against fallout radiation. Some buildings, however, are better than others. In the Fallout Shelter Survey over 155 million shelter spaces were located by January 1, 1967. Many other buildings would have provided adequate protection, but they had weak points which nullified otherwise good protection. These weak points can be detected by someone knowledgeable in radiation shielding analysis during the initial design phase of the project, and "no-cost" design changes could be incorporated to maximize the protection without exceeding budget limitations.

Examples of items to be considered in slanting are:

a. Location and quantity of window areas - Could window areas be reduced or could sills be raised to reduce exposure to radiation?

b. Site conditions - Is the structure located so that maximum advantage is taken of mutual shielding from adjacent structures? Has consideration been given to use of retaining walls, planters, overhangs or grading a slope away from the structure to minimize the effect of radiation from the ground?

c. Basement - Is it possible to depress the ground floor partially or completely below grade to reduce the effect or radiation from the ground?

* Supersedes TM 64-2, dated August 1966 which MAY be used

d. Entrances and Exits - Have these been located to maximize the protection by baffles or do they permit direct entry of the ground radiation? Can stairwells be positioned so that they provide additional shielding at the ends of corridors and hallways? (See figure 1)

e. Have interior partitions been placed to block radiation?

f. Have dense, solid walls been used advantageously? Have hollow walls been filled with low cost materials where feasible? (See figure 2)

g. Floors and Roofs - Has a comparison been made of various systems such as concrete slabs on pre-cast tee beams or bar joists, composite floor systems such as tile or terrazzo on concrete, or two-way slab design versus pan-joist construction? Cost differentials may be negligible but one system may provide significant additional shielding. (See figures 3 and 4)

h. Architectural Arrangement - Has maximum advantage been taken in arrangement of the building modules to provide a protected core area which could be used for shelter?

If the protective requirements are clearly understood, the architect-engineer will find many ways in which the building can contribute to the safety of personnel and material without an increase in cost and without sacrificing esthetics and efficiency. This procedure might not always provide shelter spaces with high protection factors, but certainly will provide some protection at no cost.

Enhancing Shelter Characteristics at Minimum Cost

In addition to using the slanting procedure noted above, there are other low cost techniques in handling shielding and geometry factors which would enhance inherent shelter characteristics to meet OCD standards and criteria.

Examples of some of these low cost techniques are:

a. Wall Construction - Has consideration been given to utilizing reinforced concrete or concrete block construction in lieu of light weight aggregate block or other light weight wall construction? Have low cost opportunities been exploited such as use of hollow tile or concrete block with sand or gravel fill to provide additional mass in interior and exterior walls? (See figure 2)

b. Esthetics - Has consideration been given to providing masonry screen walls, or planter boxes for esthetic value as well as increasing the mass for shielding purposes? (See figure 5)

c. Floor and Roof Construction - The addition of a few inches of concrete topping to a pre-cast concrete tee roof or floor slab system will do much to enhance the protection afforded occupants.

d. Site and Earthwork - By judicious site work and location of earth berms, it is possible to improve the shelter provided in a structure.

Cost Reduction Techniques

A number of techniques have been devised which should reduce the cost of obtaining shelter spaces. They are as follows:

a. Ventilation - The requirements for ventilation of buildings incorporating shelter should be based on normal usage of the facility. Where increased ventilation is necessitated to utilize the full capacity of the shelter area and make it habitable, consideration should be given to the use of packaged ventilation kits now being developed by the Office of Civil Defense in lieu of increasing the capacity of the permanent ventilation system.

b. Trapped Water and Sanitary Facilities - The requirements for a supply of potable water necessary for survival constitutes one of the fundamental problems in achieving shelter habitability. A minimum of $3\frac{1}{2}$ gallons should be available for each shelter space stocked. The Federal Government provides austere emergency rations and supplies to those spaces designated as public fallout shelters. In addition to these supplies, potable water may be furnished to the shelter from a variety of sources. These include entrapped water in building systems, wells, tanks, steel drums with plastic liners as furnished by OCD, or a combination of any of these sources. In stocking public fallout shelters, a determination will be made as to the most effective and desirable means of assuring the availability of the required water while minimizing cost and storage requirements.

The disposal of human waste in the shelter may be accomplished by a variety of methods including use of the existing sewerage systems, manholes providing access to sanitary or storm sewers, diversion of systems containing nonpotable water for flushing purposes and the use of the OCD furnished drums as chemical toilets. Where the water sypply is furnished by means other than the OCD water storage container, the sanitation requirement may be met by furnishing a smaller number of drums than would be normally provided for water storage.

c. Food - Public fallout shelters qualifying under the Federal Program are provisioned with OCD packaged food supplies. The amount of the standard ration to be placed in the shelter may be reduced if the equivalent food is available and certain other requirements pertaining to perishability and availability are met.

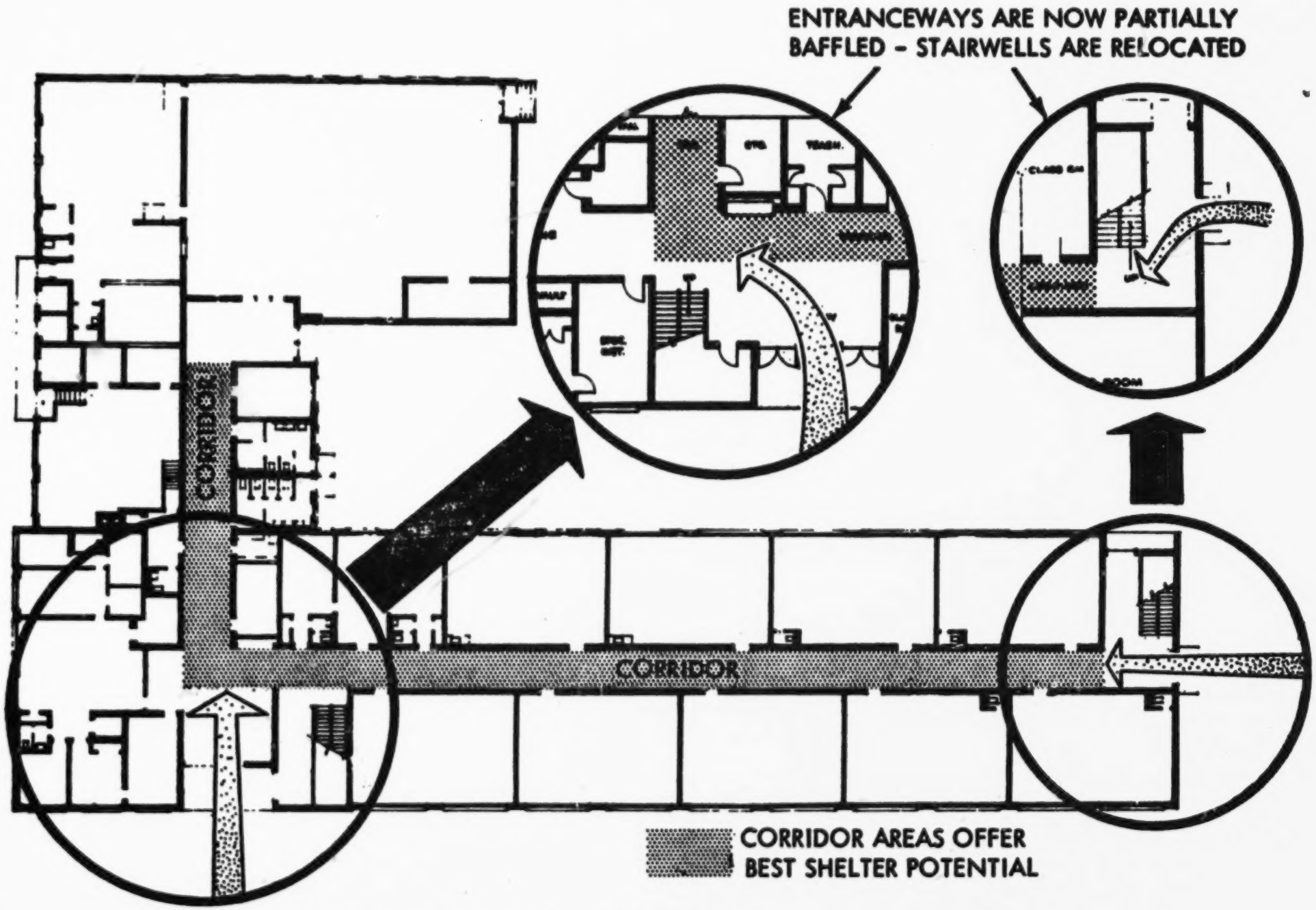
New Criteria and Technology

TM 61-3, "Minimum Technical Requirements for Community Shelters," has been revised and updated. Since the initiation of the National Fallout Shelter Survey Program in 1961, methods of radiation shielding analysis have been refined so that a more accurate analysis can be obtained in a shorter period of time. This will enable the designer to make a more precise calculation on the mass thickness of walls and roof necessary to provide adequate shelter. Since the previous methods were on the conservative side, the more precise calculations should enable cost reductions to be realized.

OCD Professional Development Program

The Office of Civil Defense sponsors a number of tuition free professional development courses at schools and universities throughout the country to acquaint architects and engineers with the techniques for radiation shielding analysis and design. Architects and engineers, interested in participating in these courses, should contact their local, State, or Regional Civil Defense Office or write to the Architectural and Engineering Services Division, OCD, Washington, D.C. 20310 for further details.

———//———



FIRST FLOOR PLAN - TYPICAL ELEMENTARY SCHOOL

Figure I

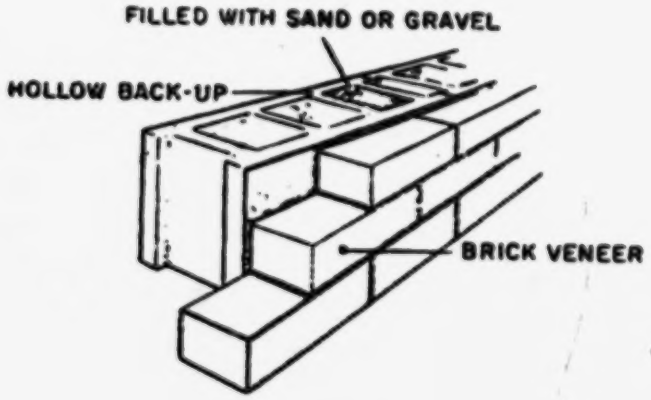
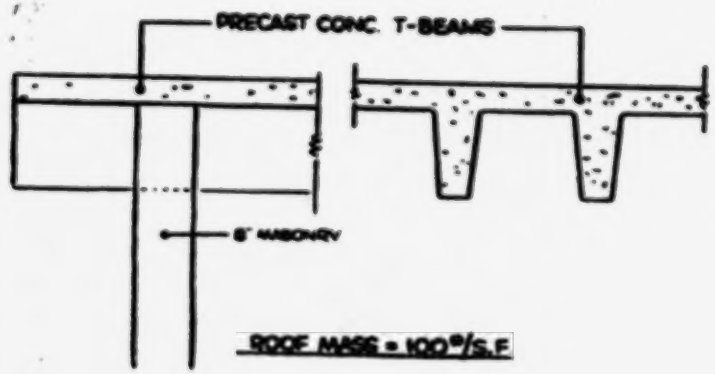


Figure 2



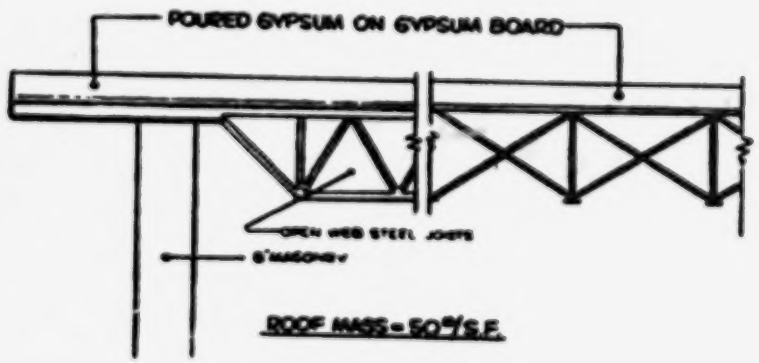
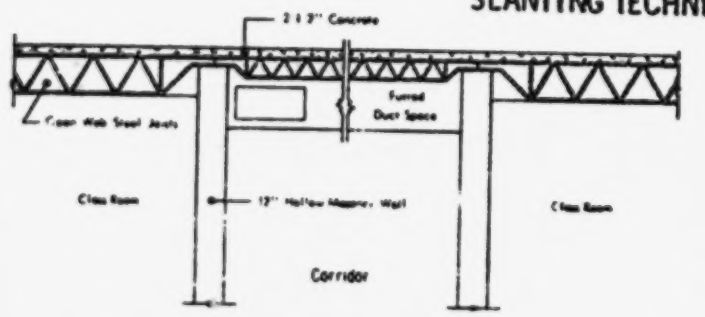
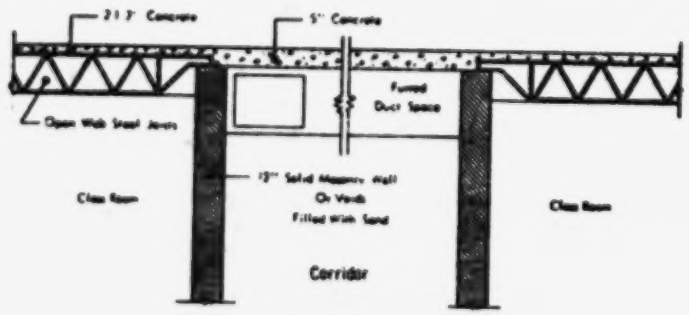


Figure 3

SLANTING TECHNIQUES

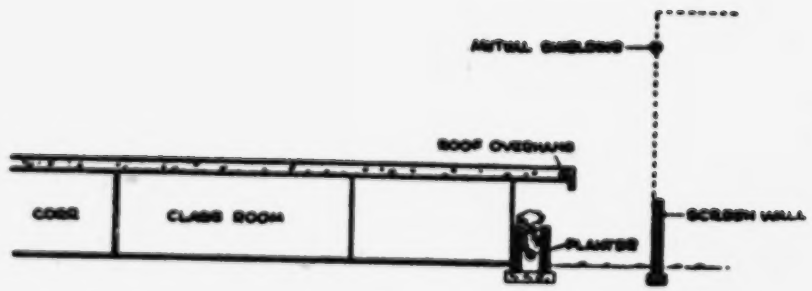


NORMAL CONSTRUCTION
ROOF MASS = 31#/S. F.



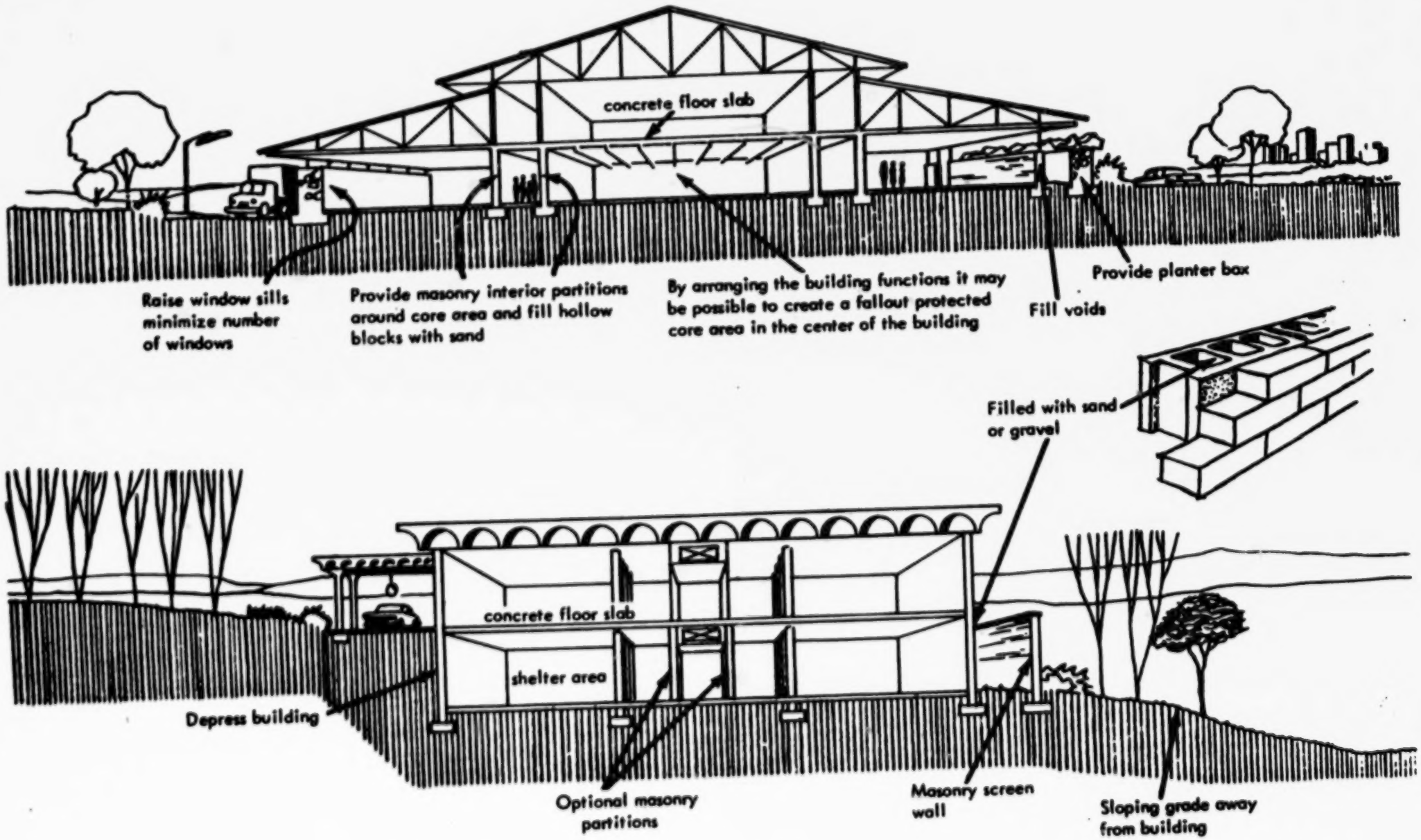
ENHANCED SHELTER IN CORRIDOR
ROOF MASS = 62#/S.F.

Figure 4

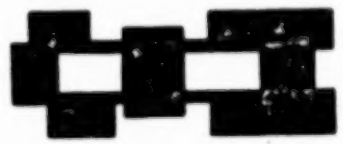
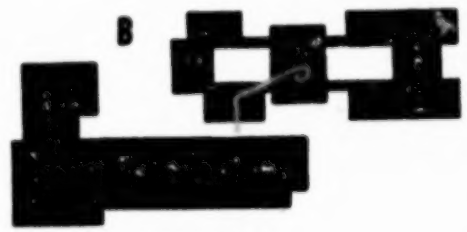
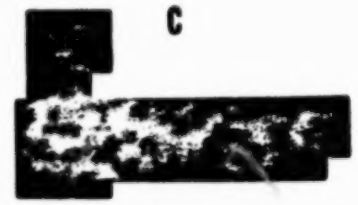


SHIELDING TECHNIQUES

Figure 5


concrete floor slab
Raise window sills minimize number of windows
Provide masonry interior partitions around core area and fill hollow blocks with sand
By arranging the building functions it may be possible to create a fallout protected core area in the center of the building
Fill voids
Provide planter box
Filled with sand or gravel
concrete floor slab
shelter area
Depress building
Optional masonry partitions
Masonry screen wall
Sloping grade away from building

SHELTER TECHNIQUES

STRUCTURE	A  CONVENTIONAL (No emphasis on protection)	B  SLANTED (Maximize protection at no increase in cost)	C  SLANTED (Maximize protection with nominal cost increase)
COST PF	$ 500,000 250 Spaces @ PF 10 250 Spaces @ PF 25	$ 500,000 325 Spaces @ PF 40 250 Spaces @ PF 20	$ 510,000 $^{+}_{-}$ 625 Spaces @ PF 40 or More
CONSTRUCTION	Large Window Area Hollow Block Walls Entrances Directly Off Corridors Panel Walls Lightweight Partitions Lightweight Roof Construction	Increase Sill Height Offset Entrances Stagger Doors & Windows Masonry Partitions Smaller Window Areas	All Slanting Techniques Fill Hollow Blocks w/ Sand Screen Walls Roof Fill Planter Boxes Roof Overhangs Increase Wall Mass Precast Roofs Depress Building Shields for Openings

GOVERNMENT PRINTING OFFICE 1967 O - 284

TR-44
APRIL 1967

SHELTER THROUGH ARCHITECTURAL DESIGN

THE SHIELDING REQUIREMENTS INFLUENCE ON FORM

OFFICE OF CIVIL DEFENSE

Attachment 3

SHELTER THROUGH ARCHITECTURAL DESIGN
THE SHIELDING REQUIREMENTS' INFLUENCE ON FORM

Objective and knowledgeable design approaches coupled with accurate shielding calculations can result in the incorporation of fallout gamma radiation protection into space without imposing upon any of the normal, day-to-day functions of that space. A shelter need not be recognizable as such. Fallout shelter spaces may be included in building types of every category without adversely affecting appearance or function and, in some cases, at no additional cost.

Almost every building shields against fallout gamma radiation, though some are better shields than others. Surveys have revealed shelter spaces for millions of Americans in existing buildings. Many other buildings were found that had weak points which could have been strengthened or avoided with little modification during design. By what criteria are buildings judged to be good or poor shelters? To explain some of these criteria, it is necessary to review briefly the behavior of radiation and fallout.

RADIATION BEHAVIOR INFLUENCING DESIGN

Gamma radiation, which is pure energy, cannot be detected through our human senses; it can be neither seen, felt, smelled, tasted nor heard. To detect this radiation,* it is necessary to use a geiger counter or other electromechanical means which may also measure its intensity.

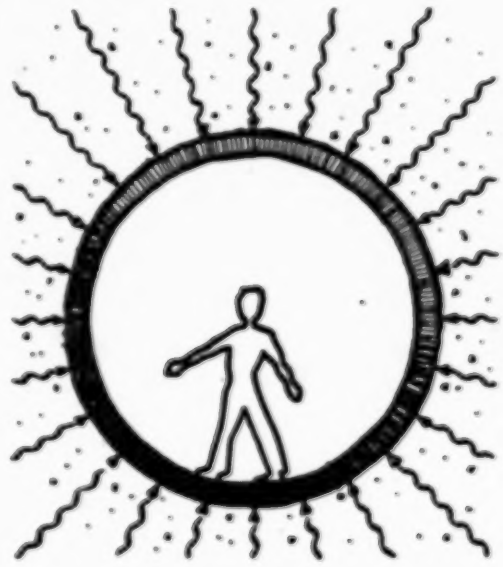
---

* The term radiation here refers to gamma radiation. Alpha and beta particles from fallout are not considered because they do not obey the same laws.

As with light, gamma radiation travels in a straight line from its source until it interacts with matter. The source may be infinitely small (i.e., a dust particle) and there may be an infinite number of sources as there is with fallout. The radiation should not be confused with its sources which, in the case of fallout, are radioactive particles attached to matter. Gamma radiation, traveling in straight lines, differs from the radiating particles which, affected by both air currents and gravity, may drift or be blown erratically to settle and collect on horizontal surfaces and to pile up in corners and depressions

IN THE EVENT OF NUCLEAR ATTACK, ANY AREA OF THE UNITED STATES COULD FIND ITSELF IN THE PATH OF CLOUDS OF RADIOACTIVE FALLOUT. RATIONAL DESIGN CAN PROTECT MAN AGAINST RADIOACTIVITY. JUST AS DESIGN, IN SOME AREAS, IS AFFECTED BY FORCES OF EARTHQUAKES, HURRICANES OR EXTREME SNOWLOADS, SO ALSO MAY ARCHITECTURE BE LOGICALLY SHAPED BY THE NEED TO SHIELD HUMANS FROM GAMMA RADIATION. THIS NEED NOT MEAN THE DESIGN AND CONSTRUCTION OF FALLOUT SHELTERS PER SE, BUT SIMPLY THE APPLICATION OF APPROPRIATE DESIGN CRITERIA TO BUILDINGS TO BE CONSTRUCTED FOR OTHER PURPOSES. MANY SUCH CRITERIA ARE PRESENTED HERE.

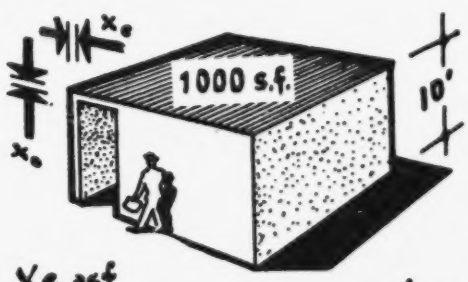
TO PROVIDE IMPETUS TO DESIGN FREEDOM, BROAD GUIDELINES RATHER THAN SPECIFIC COMPUTATIONS ARE GIVEN. WHILE SUCH GENERALIZATIONS ARE NECESSARY, NOT TO BURDEN THE DESIGNER IN PRELIMINARY STAGES, THE DETERMINATION OF THE DEGREE OF PROTECTION AFFORDED MUST BE LEFT IN THE HANDS OF COMPETENT CONSULTANTS.



THE SHIELD should have considerable thickness and density – in reducing radiation, it provides protection –

Each dust particle = a tiny source of radiation

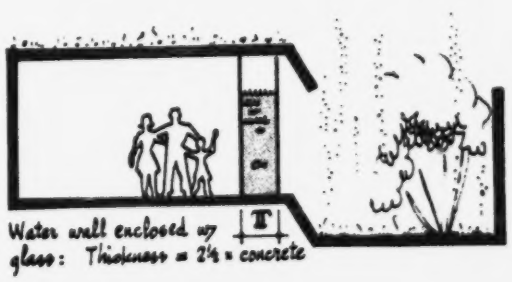
A less dense material (such as earth) may shield if thickness is increased -



Xe psf

Xo psf → / ← Xe psf	50	100	200	300
50	4	5	5	5
100	7	12	15	15
200	14	40	115	145
300	15	55	345	910

PF's



Water wall enclosed by glass: Thickness = 2½ " concrete

and at intersections of horizontal and vertical planes. Radiating particles congregate on the roof and ground, becoming solid planes of radiation, more "alive" than the surrounding atmosphere itself through which they fall. This accumulation of radioactive matter is called "contamination."

Unlike light, gamma rays tend to penetrate solid, opaque masses of materials which absorb radiation according to their unit weights or "masses." Some rays, in passing through mass, are "scattered"—that is, their directions and energy are changed. These characteristics account for shielding criteria and become architectural form-determinants.

SHIELDING PRINCIPLES

Protection from fallout may be achieved in the design of buildings through the application of four basic form principles—barrier and geometry shielding, distance and time.

BARRIER SHIELDING: Affording protection by absorption or capture of radiation, a shield's governing characteristics are thickness and density, and the more mass or unit weight the better. A less dense shield will have to be increased in thickness. One of the most economical shielding materials is concrete, but any masonry—singly or in combination—or even a thickness of earth or water is capable of attenuating or blocking radiation. Slip-form, tilt-up, load-bearing, and precast masonry panels are all likely to provide good shielding ability with economy.

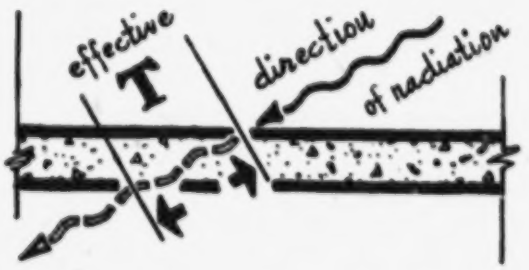
While water could be used as a shield to offer a view of the outside, a water wall enclosed by glass would be an elaborate and costly solution. It is a less expensive solution, however, than an equivalent thickness of solid glass. A flat overhead canopy-like water tank that is full could shield. A layer of stored bulky material or mechanical equipment (overhead or to the side) would seem to be a logical bulwark, but caution would reveal that its density may vary greatly in space and time. Shielding then, should normally be of a permanent, immovable nature.

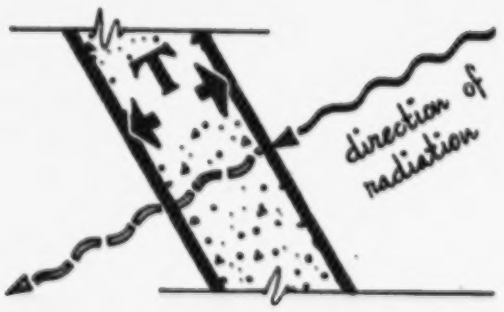
Varying barrier thicknesses, such as with pan construction or a shell whose thickness is not constant, can often be averaged or "smeared." With a folded-plate roof or undulating wall, the total material involved should equal that in a flat-plane shield. Where radiation is directional and strikes the shield at an angle, the effective shield thickness is increased.

The handling of combinations of floors, roof slabs and walls surrounding all types of spaces adjacent to or over and under the shelter will enhance shielding. The protection value of each is cumulative. Some current buildings such as Harvard's educational building by Caudill, Rowlett, and Scott, Yale's architecture building by Paul Rudolph, Eero Saarinen's conglomerate-masonry dorms are quite in sympathy with the application of the barrier shielding principle.

Consider barriers an average thickness.

GEOMETRY SHIELDING: Radiation reaching any given point in a building may come from all sides and penetrate walls, roofs and floors, so the positioning of these elements with relationship to each other (all of which shield) may be fully as important as their unit weights. An arrangement of staggered baffles set up in a simple maze (similar to Indiana University's Clowes Memorial Hall Auditorium by Evans Woolen) can provide light and air with protection. A double layer of giant louvers at right angles to each other could serve. This is similar to the fresh air louver into a darkroom which admits air but blocks light. Some of Louis Kahn's "building within a building" schemes, with perforated concentric enclosures, approach quite workable solutions.

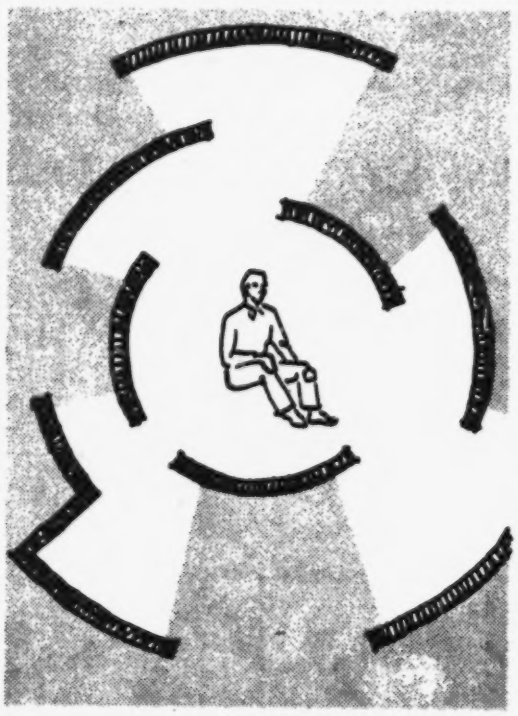




These shields are of equal value, though one is half the thickness of the other.

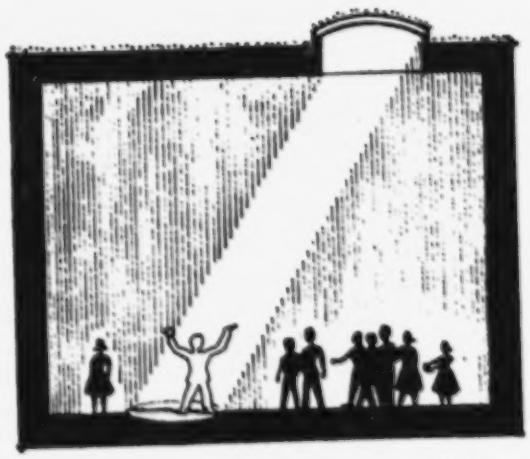
The handling of openings is critical. Entrances to lobbies or corridors may be shielded to a large degree by stairways or courtyard walls. Since reflection (or bouncing) of rays is secondary, another simple solution to decrease direct entrance or "streaming" of rays of radiation is to provide a right-angle turn (vertically or horizontally) between the entranceway and the interior shelter space.

Though windows need not be eliminated, extreme care must be exercised in their placement. Ingenious designs from OCD shelter competitions show that careful placement of shields permits surprising expanses of fenestration.

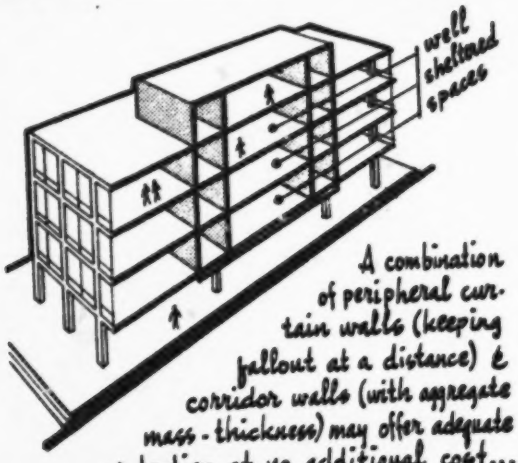


Light wells and skylights are not out of the question if their exposed areas are small and their heights above the occupancy level are sufficient.

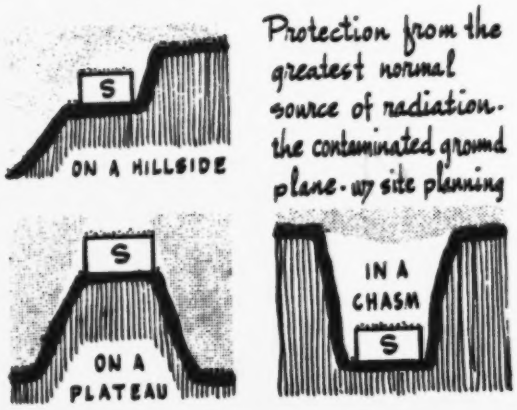
An open-ended corridor or other horizontal aperture, provided it is discreetly sized and remotely located, may provide a psychological outlet. Unglazed openings, if provided with maze shielding, are also possible. Consensus of many research projects along this line is that infiltration of radioactive particles borne by natural or mechanical ventilation is likely to be negligible. If necessary, it can be swept up and removed.



A small skylight is sometimes possible...



A combination of peripheral curtain walls (keeping fallout at a distance) & corridor walls (with aggregate mass - thickness) may offer adequate protection at no additional cost...



Protection from the greatest normal source of radiation - the contaminated ground plane - by site planning

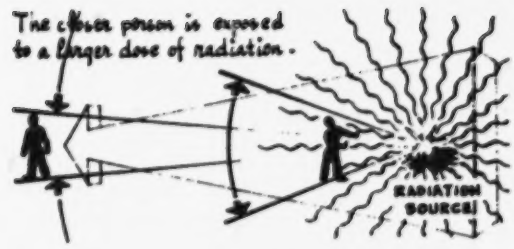
It is possible for shielding to be physically removed or separated from the shelter space. This is called "mutual shielding." Two adjacent structures may shield each other if they are close enough and ground area between them is limited, thus reducing the size of the contaminated plane. Their positioning, in section and plan, must be precise.

Blocks of building elements may be so massed as to provide a protected core. Montreal's Place Ville Marie, some of the Scarborough College complex (University of Toronto), and many rotunda spaces would approach such a scheme. Any hollow well, covered court or patio will provide some protection if surrounded by a ring of building mass. The core of Wright's old Larkin Building in Buffalo was a likely space. The fallout on the roof, however, must also be considered.

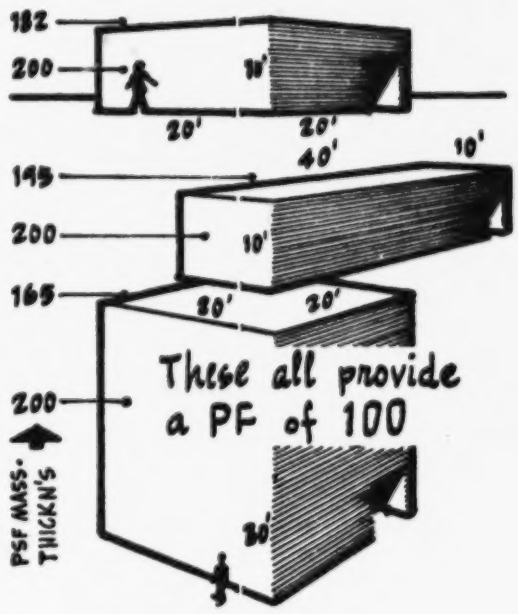
Shielding through geometry should extend to planning of the site. Retaining walls, planters and earthen berms around openings can minimize ground surface radiation—normally the greatest source—and permit lessening (or elimination) of barriers built specifically for shielding. A slight slope away from the building on all sides can decrease radiation from that plane to the building's ground floor. Siting the building against a hillside, on a plateau or in a chasm would utilize the most inexpensive shielding material of all—earth. And of course any depression or submersion of the building below grade will rapidly reduce radiation to the interior. Many basements, even with a minimum of windows and a portion of aboveground exposure, provide adequate shielding for all but the most intense radiation. A moat or encircling depression around the building would allow fallout to be deposited in a trench where it would decay with little penetration of harmful radiation into upper shelter spaces. Paolo Solari's earth sculpture forms would contribute very nicely to the shielding capability of structures if carefully thought out and executed in terms of the radiation shielding function.

DISTANCE: Protection may be afforded through physical separation of the radiating particles from the shelter. Layers of air may, through attenuation of radiation, afford protection. Theoretically, a large Buckminster Fuller geodesic dome or even a giant inflated balloon enclosing a neighborhood (if unaffected by atomic blast) could radically reduce the need for shielding immediately surrounding a shelter space.

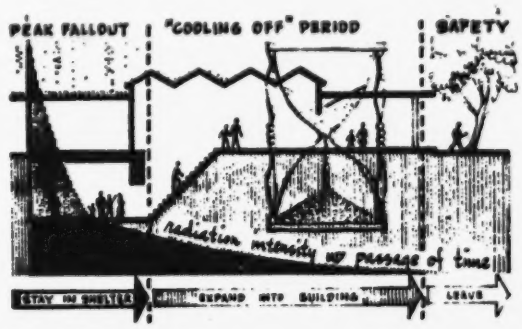
While a smaller shelter permits a maximum reduction of peripheral shielding (because of the smaller space enclosed), it requires a shield of greater thickness. The closer proximity of the radiation sources requires the envelope to assume a bunker-like character.

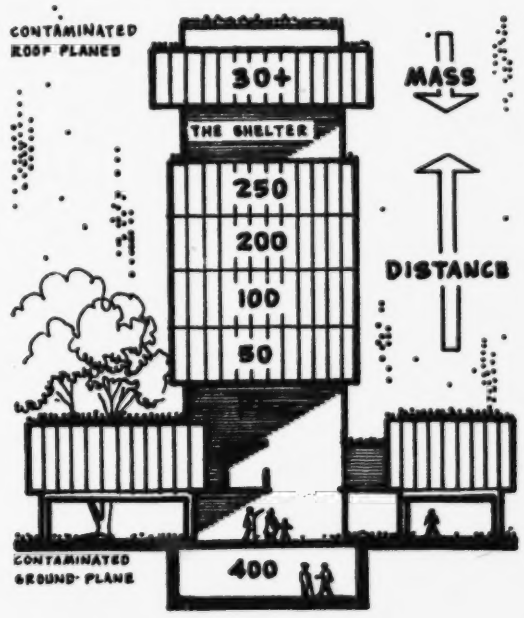


TIME: The rate of emission of radiation by fallout decreases rapidly following detonation. Taking advantage of this decay characteristic, the architect may lay out his shelter and its surroundings to permit a modulated expansion of shelter occupants after the initial "hot" period. Spreading out into more spacious quarters with thinner screens as the radiation intensity decreases would provide an important psychological boost. Following a detonation, fallout accumulates within a predictable period of time. Fifty to 70 percent will be within 24 hours; the remainder will be delayed, depending on high altitude winds, size of particles, proximity to ground zero, and other factors.



With these notes on radiation behavior and shielding principles, the architect has some simplified design tools to add to his general knowledge of functional, structural and mechanical considerations. These rough rules-of-thumb are adequate only for preliminary design. Just as complete design processes are necessary in the structural and mechanical aspects of every building, so are computations necessary in evaluating each shelter design.





CHECKLIST OF BASIC DESIGN TOOLS

Barrier:

1 Use precast, tilt-up, slip-form and bearing walls instead of lighter-weight materials.

2 Work with concrete tees and prestressed masonry units instead of light-weight floor and roof assemblies; detail roof fills.

3 Arrange multiple thicknesses of walls, floor, and roof slabs surrounding the shelter space.

4 Employ courtyard walls, planters and neighboring buildings for shielding.

5 Fill hollow blocks with sand or gravel, or otherwise increase weights (mass thickness) of shielding walls.

Geometry:

6 Place shelter in inner core corridor area or basement.

7 Form earth berms, moats, pedestals, platforms or other sculptured earth shapes; slope grade away from building.

8 Carefully position and proportion overhangs and fascias.

9 Provide right-angle turns at entrances; stagger openings to obviate radiation's "streaming" in.

10 Reduce window areas; raise sill heights to shield against ground radiation.

Distance:

11 Enlarge building envelope; position shelter remotely from peripheral walls; raise a canopy high above sheltered floor.

12 Place shelter in upper two-thirds of a multistory structure, with two or more floors above.

Time:

13 Surround maximum protected space with less shielded expansion areas—an arrangement called a "graded shelter."

14 Line shelter with food storage or other usable stock; its use (and removal) would coincide with the diminishing need for shielding.

15 Make use of pools of water outside shelter to act as catch basins for fallout which would settle to bottom and be attenuated by the mass of the water covering it.

Developed for OCD by Prof. Samuel T. Lanford, Assistant to the Chairman, University of Illinois, Department of Architecture